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Electric Light for the Farmstead


Farmers' Bulletin No. 1838


U. S. DEPARTMENT OF AGRICULTURE


INSTALLING LIGHTING fixtures and necessary wiring involves considerable expense, and mistakes are wasteful. Therefore, it is essential that the consumer become familiar with good lighting practices before purchasing and installing lighting equipment. The following steps are suggested as a guide in planning the installation:


 Analyze the work, study, and play carried on in each room of the house. List the tasks that may be done by general lighting and those that require local lighting. Table 3 on page 41 will be a help in doing this. Group the "seeing" activities that may be carried on around the same lamp.

 Provide general lighting with switch control if possible for each room, hall, and stairway. This is usually done by means of ceiling fixtures; good types are illustrated in the bulletin. Simple enclosing globes will give well-diffused general lighting at minimum cost. General illumination can be provided in the average-sized room by good portable lamps of the Illuminating Engineering Society type. This is frequently done in the living room.

 Provide local lighting suitable for each group of activities. Wall brackets provide local lighting over work areas such as sink, range, and work tables. Portable lamps provide local lighting for activities such as reading, writing, or sewing. If the expenditure must be kept to a minimum, select one good lamp and adjust the activities around it. If necessary, the lamp may be moved from room to room.

 Follow similar procedure in planning light for outdoor paths and in the barn and other buildings.

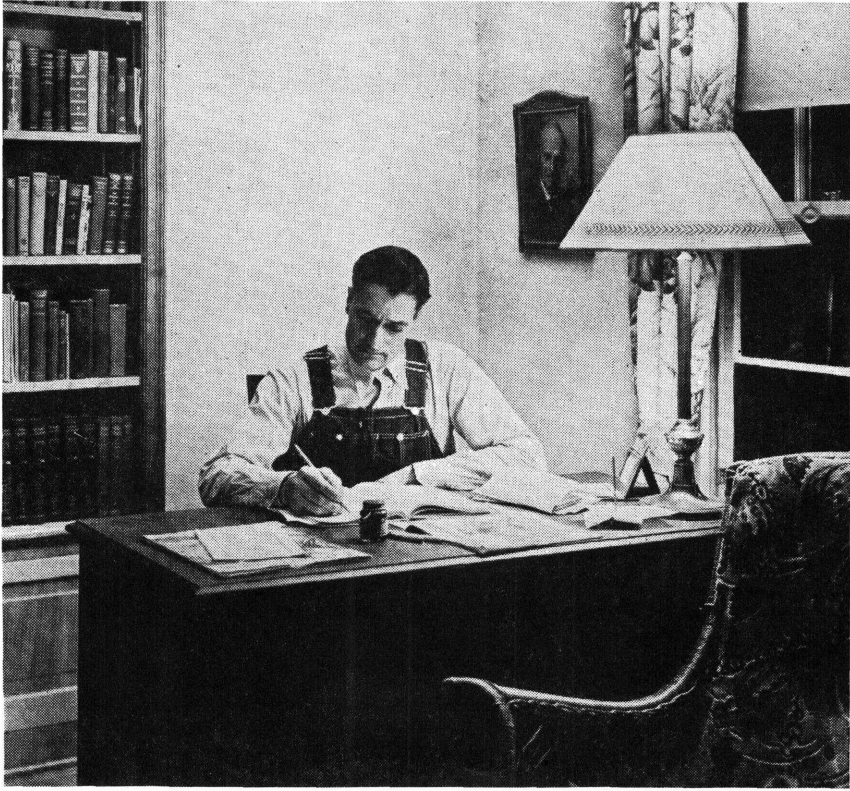
 Recommended sizes of light bulbs found throughout this bulletin are larger than those found in the average home. However, they will provide illumination which tests have indicated is desirable for most individuals and which the majority of people will want once they have experienced it.


 Adequate-sized wiring is essential for satisfactory and efficient use of electricity. Before any wiring is done, analyze the needs for lighting and other equipment and see that the wiring installed is of proper size to carry the expected load.

also later Ed.

Electric Light

FOR THE FARMSTEAD



 PREPARED BY THE BUREAUS OF
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ENGINEERING AND HOME ECONOMICS

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The importance of good lighting

■ SEEING is dependent on three things—the eye, the object, and light (fig. 1). Of these three, the one that is easiest to control is light. Thus, when seeing becomes difficult, we often take our work to a location where light is better or provide additional artificial light on the work.

If light is inadequate, the endeavor of the eyes to adapt themselves to the situation may cause eyestrain, which, if it occurs frequently, may cause the eyes to become permanently impaired. This is especially true with children. The eyes of older people lose some of the

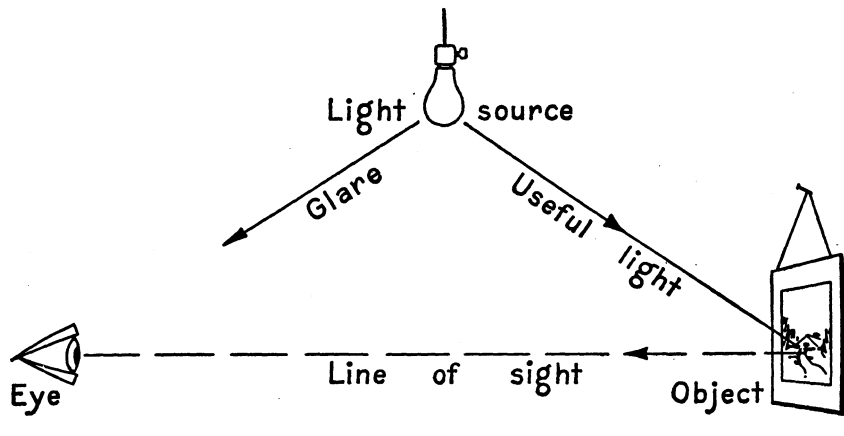


Figure 1.—Three factors in seeing—the eye, the object, and light

power to adjust themselves to different amounts of light and to see small objects. Improved lighting helps compensate for both of these conditions.

The ease with which objects may be seen depends on their size, contrast, brightness, and the length of time they are exposed to view. In any light **this type is easier to read than the rest of the page** because the letters are heavier than the others. The contrast of black ink on white paper makes the page easily legible. A bit of glass or shiny metal may catch the eye because of its brightness. A stationary sign is read with ease whereas the same sign on a moving vehicle might not be legible.

Good light is an aid to good health as well as to the comfort and the efficiency of the worker. Nervousness and irritability, mental depression, physical weariness, and impairment of certain bodily functions often may be traced to eyestrain.

Light has an important bearing on cleanliness. With good light, cleanliness is more easily attained.

The convenience and adequacy of a lighting system are also important to safety. Many an accident might have been prevented had stairs or pathways been adequately lighted.

Essentials for good lighting

Amount of light

■ THE first requisite of good lighting is that there shall be a sufficient amount of light provided to make clearly visible the object or surface being observed.

We are not so accustomed to thinking of light in terms of measurable quantities as we are to thinking of acres of land, bushels of

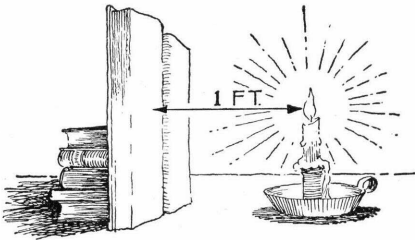


Figure 2.—The illumination produced on a surface 1 foot distant from a lighted standard candle is known as a footcandle

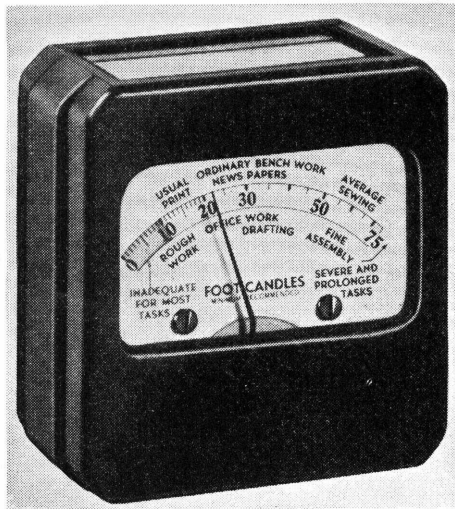


Figure 3.—A typical light meter



Figure 4.—This light meter for checking illumination in footcandles is placed in the location of the work for which the light is being tested. The lamp shown has a 10-inch diffusing bowl and uses a 100–200–300-watt, 3-light bulb. It provides adequate light for reading, writing, ordinary sewing on light cloth, and other tasks requiring close vision. If walls and ceilings are light in color, it also provides considerable general illumination

wheat, tons of coal, or degrees of temperature, yet there is a unit of light measurement that is just as definite as any of these. The unit used for measuring illumination is the footcandle (fig. 2), and the light meter (fig. 3) is an instrument used for measuring the number of footcandles whether the light is supplied by the sun or by artificial means.

The light meter at the present time is too expensive an instrument to become standard home equipment, though in many places it is made available for use by the local power or electric company or the home-demonstration agent. The recommendations throughout this bulletin are therefore general and are not made in footcandles. It is believed that the sizes of the bulbs suggested to provide illumination for various tasks will be found satisfactory when used in homes with average ceiling heights and walls and ceilings of reasonably light color. It is suggested however that, when possible, the local representative of the Rural Electrification Administration or the electrical

service supply agency be consulted as to the number of footcandles recommended for various tasks, and that a light meter be used to aid in planning for new or improved lighting.

When the light meter is used it should be placed in the location where reading and sewing, or other work, would naturally be done (fig. 4). Care should be taken to see that the meter is held at the same angle as that of the book or work. Illumination decreases rapidly as the meter is moved away from the lamp; even a few inches difference in distance may result in a great change.

Quality of light

Quality in lighting depends on freedom from glare, the control of shadows, and the absence of sharp contrast between lighted objects and their background. Glare may be defined as excessive brightness which causes discomfort or eye fatigue. It can be minimized by shading the light bulb with a diffusing material, or by placing the source of light well above the level of the eyes.

Opal or milky glass, diffusing plastics and parchment paper, or light-colored, lightweight silks are good diffusing materials as they not only permit light to pass through them but also soften it. Glass and

Figure 5.—A common type of lamp that concentrates light on the work but produces unpleasant contrast of light and dark. If the desk top is polished, if the paper has a shiny surface, or if there are shiny objects on the desk, glare caused by reflected light may result from a lamp in this position

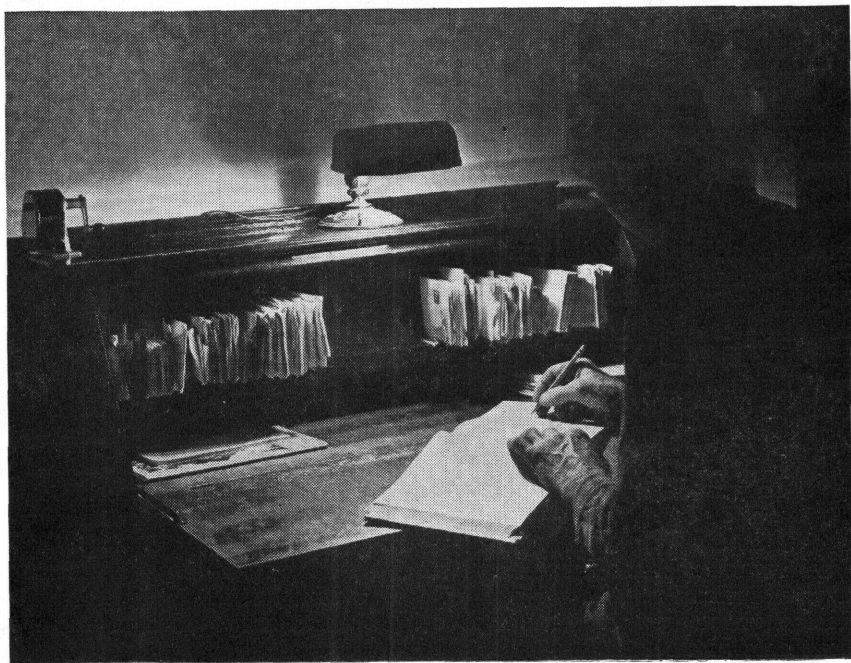




Figure 6.—This type of portable wall lamp placed above the desk provides good illumination for writing as well as general lighting. Since most people are right-handed it should be placed at the left. This lamp has a 6-inch diffusing bowl and a 75-watt bulb. With a larger desk, or if the lamp is placed at a greater distance from the work, a lamp with an 8-inch diffusing bowl and a 100-watt bulb should be used to give the proper spread of light and the required illumination for writing

plastics are used for diffusing bowls, while parchment paper, fabrics, plastics, and other materials are used for shades.

Reflected light also may cause glare. Mirrors, pictures, glass or metal objects, table tops, or even glossy paper may reflect light into the eyes. This reflected glare can usually be avoided by changing the position of the reflecting object, of the worker or his work, or of the lamp.

Shadows are affected by the placing of the light source and by the type of lighting used.

Contrasts of light and dark may cause much annoyance. Any comparatively bright light source in an otherwise dark area requires eye adjustments to the contrasting degrees of light (fig. 5), a process which when repeated may be tiring and irritating to the eyes. Since high illumination is necessary for local activities, the general illumination throughout the room should be sufficient to eliminate sharp contrasts (fig. 6).

Color of light

Artificial light usually differs from natural daylight in its color. For many activities this is not of great consequence, but it is important if colors must be matched or combined. Blue daylight bulbs provide light similar in some respects to daylight and are used where the choice or the matching of colors is involved, as in stores. However, these bulbs are more costly to buy and require a higher wattage to get the same amount of illumination that is produced by a regular inside-frosted bulb. The use of colored bulbs or shades that color the light should be avoided except for special decorative purposes, as they give much less light for the same number of watts and distort the appearance and color of furnishings.

Wiring for good lighting

■ It is the responsibility of the farm family to see that the contractor installs wiring in the house and other buildings adequate to carry the current needed. If too small wires are used to carry the current required, the voltage may drop excessively. This drop in electrical pressure decreases the amount of light given out by bulbs and affects the operation of motors and the rate of heating in cooking and heating appliances, thus materially reducing their efficiency.

For safety, economy, and convenient service, electric wiring must be carefully and correctly designed and installed. Bulletins on farm and home wiring in which recommendations are made for the kind and amount of wiring needed to give efficient service are available from some of the State agricultural colleges, from manufacturers, and electrical service supply agencies. Wiring should be done preferably by a reputable electrical contractor familiar with farm service requirements. It must conform to State and local regulations and to the specifications as set up by the service agency.

Types of electric outlets

Four types of outlets are used in wiring: Light outlets in which the light fixture is permanently installed; convenience outlets for attaching portable lamps or small household and farm appliances; power outlets to which heavy-duty appliances such as ranges, water heaters, or large motors are attached; and switch outlets for controlling the current to light, appliance, or power outlets. Switch outlets do not consume current.

Convenience outlets should be located at points of greatest use. There should be enough outlets to permit the use of lamps or appliances in any part of the room where they may be wanted. This is

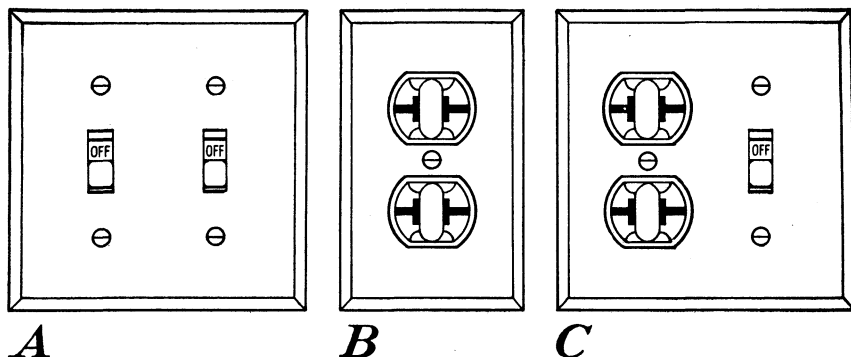


Figure 7.—A, Toggle switches used for controlling light or convenience outlets; B, double convenience outlet; C, combination of double convenience outlet and a toggle switch controlling another outlet

especially true of the living room for the connection of portable lamps and radio, and in the kitchen where various appliances are used. Double or triple convenience outlets are economical since they allow greater and more flexible use of appliances and lamps and usually cost no more to install than single ones (fig. 7, *A*). Convenience outlets may also be incorporated with wall switches, wall brackets, or light outlets, increasing flexibility of use, and in some cases decreasing installation costs (fig. 7, *B*, and *C*).

Toggle or tumbler wall switches are preferable to pull chains or switches at the fixtures, as they are more durable and make it possible to turn on the light as one enters the room. When houses already built are wired it is frequently necessary to use surface and pull switches. For safety and convenience at least one lamp or fixture in each room should be controlled by a switch near the entrance and exit to the room. If two doors are far apart, it is desirable to have a switch by each so that it is never necessary to cross a room in the dark or to retrace one's steps to turn off a light. Switches that control a light from two places are known as three-way switches.

Light for the farmhouse

Natural light

■ DURING daylight hours windows control the amount of natural light admitted to the house. The upper part of the window is the more important because light entering through it will penetrate farther into the room than that entering through the lower part. It is usually considered that under average conditions in the United States window area equal to 15 to 20 percent of the floor area will give good natural lighting in the dwelling house. This is true when the windows are well spaced and not excessively shaded by porches, trees, or other obstructions. If the windows are fully exposed to light, somewhat smaller areas may be satisfactory and will simplify the control of temperature in the house. In regions of intense sunlight, window areas may be smaller than those in cloudy regions, or large windows may be protected by awnings, porches, or verandas. In the humid South large windows are desirable for ventilation.

Windows in rooms where good light is needed should be kept free of heavy curtains, draperies, or shades. Even screens or thin window curtains may cut down the light to a surprising extent. Curtains may be needed for privacy, or in some cases to soften intense sunlight, but should be so arranged that they can be pulled back. Draperies should be hung so that they cover the casing rather than any considerable part of the windows. Light-colored shades that admit some light are better than dark shades if they are to be used in the daytime. Venetian blinds are good because they can be adjusted to shut out the direct rays of the sun but still admit light.

Artificial light

Different activities in the farmhouse require different amounts of artificial light. Also, individuals vary in their requirements for light for the same job. Throughout the house there is need for general lighting to permit moving about in safety, to find things easily, and to make the rooms cheerful. In the kitchen and laundry the tasks require a somewhat higher general illumination. Reading, writing, studying, sewing, and needlework all involve close seeing, often for long periods, and therefore require ample light.

The illumination that will be furnished at a given spot by a light of a given size and type depends on the size and height of the room, the color and texture of walls and ceilings, the type and cleanness of the fixtures, the distance from the light source, and other factors. The illumination cannot be predicted, unless all these conditions are known.



Figure 8.—The light walls and ceiling of this bedroom aid in effective lighting, minimize shadows, and give the room a comfortable, pleasing appearance. Note again the portable wall lamp, using a 6-inch diffusing bowl and a 75-watt bulb, over the bed. It is placed low and will afford good light for reading. The semi-indirect ceiling fixture with a 14-inch plastic bowl uses a 150-watt bulb and provides very satisfactory general illumination in a medium-sized bedroom

Effect of walls and ceiling on quantity and quality of light

The effectiveness of light supplied in any room depends to a large degree on the color and texture of the walls and ceiling. The darker the color, the more light it will absorb. In a room with dark walls or ceilings or with large areas of dark furniture, more light must be supplied to obtain the same illumination than is necessary when light colors are used (fig. 8).

The ceiling is the most important area because much of the light in a room is directed upward, especially in modern lighting. A light-colored ceiling will reflect the light, thus adding to the general illumination of the room.

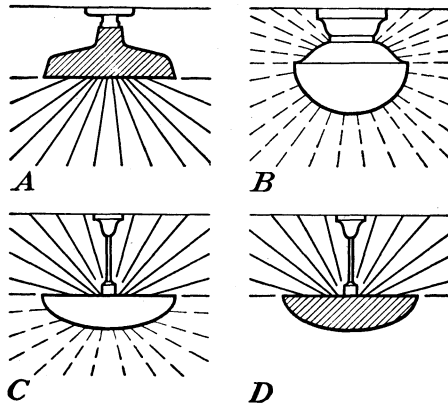


Figure 9.—A, Direct-type lighting fixture; B, semidirect-type lighting fixture; C, semi-indirect-type lighting fixture; D, indirect-type lighting fixture

Walls and ceilings should have a mat or dull surface, since surfaces without gloss diffuse and distribute the rays and give a comfortable light. Glossy walls and ceilings, which reflect light in the same way that glass and metals do, may cause glare.

Types of lighting

Lighting fixtures are designed to distribute light directly, indirectly, or in both ways. Direct lighting fixtures (fig. 9, A) send the greater portion of the light rays directly to the area to be lighted, and as a result usually produce the highest degree of illumination. The open-reflector type produces the highest illumination, but at the same time gives strong, sharp shadows, and may cause unpleasant glare. Proper shading of direct-type fixtures decreases glare and sharp shadows.

Indirect-lighting fixtures (fig. 9, D) send all of the light rays to the ceiling, upper walls, or other reflecting surfaces such as window shades, which diffuse or scatter these rays and reflect them back to parts of the room where they are needed. With indirect lighting, the ceiling functions as part of the lighting system, so it is essential that it be

finished in a light color with a dull surface. Indirect lighting is especially suitable for general illumination because it gives a soft and more even distribution of light throughout the room with no sharp shadows.

Semidirect and semi-indirect lighting fixtures send part of the light directly to the work and part to the ceiling to be diffused throughout the room. Semidirect light fixtures (fig. 9, *B*) send the major part of the light rays downward for certain specific jobs and at the same time furnish some general illumination to reduce contrasts of light and dark areas, by upward rays. Semi-indirect lighting (fig. 9, *C*) sends the greater portion of the light rays to the ceiling, but some are directed downward. This type of fixture does not provide sufficient local lighting for close-seeing tasks unless hung low, as over the dining table. It may be used where localized activities do not require close seeing.



Fixtures, portable lamps, and bulbs

There are two types of lighting equipment: Fixtures permanently attached to ceiling or walls; and portable lamps such as table, floor, or wall lamps, that can be moved to any desired location and plugged into a convenient outlet.

WALL AND CEILING FIXTURES

Descriptions of various types of wall and ceiling fixtures with suggestions for their use follow. The recommended size of bulbs in watts¹ and the proper size of enclosing globes or shades are also given.

Attached Lighting Fixtures

Type of fixture	Description and uses
	<p>Diameter: 12-inch for 75- to 100-watt bulbs; 14-inch for 150-watt bulbs.</p> <p>Furnishes direct lighting for general illumination and specific tasks. (See fig. 20.)</p> <p>Suggested locations: Basements, laundries, utility rooms, etc.</p> <p>Mounting: Usually at the ceiling.</p>
R. L. M. ² dome reflector. Direct-type ceiling fixture.	
	<p>Diameter: 8-inch for 60-watt bulb; 10-inch for 100-watt bulb; 12-inch for 150-watt bulb.</p> <p>Gives semidirect lighting for general illumination and specific tasks.</p> <p>Suggested locations: Kitchen, bathroom, hall, washroom, laundry. (See fig. 18.)</p> <p>Some variation of the semidirect fixture is recommended for use in room where ceiling is dark and must remain so.</p> <p>Mounting: About 8 feet above the floor; at the ceiling unless it is more than 9 feet high.</p>
Enclosing globe. Semidirect ceiling fixture.	

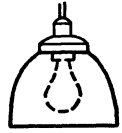
¹ The watt is the unit for measuring the rate at which electrical energy is used. The kilowatt-hour is the unit for measuring the total quantity of electrical energy used in a given period—an hour, a day, or a month. It is equivalent to 1,000 watts used for 1 hour or 100 watts for 10 hours.

² The initials R. L. M., which mean "reflector and lighting equipment manufacturers," are used in this bulletin to describe this particular type of dome reflector.

Attached Lighting Fixtures—Continued

Description and uses
Diameter: 6 inches for 75-watt bulb.
Gives semidirect light for lighting specific tasks.
Suggested location: Above sink or other work surface.
Mounting: Suspended by chain about 4 feet above working surface.

Type of fixture

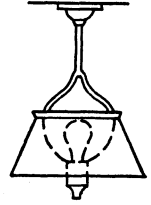


Open glass reflector. Semidirect ceiling fixture.

Diameter: Use 8-inch diffusing bowl for 100-watt bulb; 10-inch bowl for 100-200-300-watt 3-light bulb.
Gives semi-indirect lighting for general illumination and specific tasks. (See fig. 14.)
The open-top diffusing bowl directs light both downward and to the ceiling.

Suggested locations: Over dining- and breakfast-room tables.

Mounting: High enough that the work surface is evenly lighted but low enough that no appreciable part of the diffusing bowl is visible to the user. Usually 24 to 40 inches above the table. If the fixture is suspended by a chain it can be hooked up to provide headroom if the table is moved away.



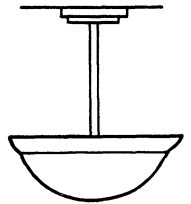
Pendant fixture with diffusing bowl. Semi-indirect ceiling fixture.

Diameter: 12-inch for 100-watt bulb; 14-inch for 150-watt; 16-inch for 200-watt. Some fixtures use 2 or 3 small bulbs to make up the total wattage.

Gives semi-indirect light for general illumination. (See fig. 8.)

Suggested locations: Living room, bedrooms, dining room, kitchen. Can be used in any room where ceiling is light in color.

Mounting: Low enough that the circle of light reaches to the walls across the narrow dimension of room, but not less than 6½ feet above the floor. Proportions and general appearance of the room may alter the height at which the fixture is hung.



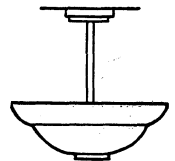
Glass or plastic bowl. Semi-indirect ceiling fixture.

Diameter: 12-inch for 150-watt; 14-inch for 200-watt bulb.
Gives indirect light for general illumination. (See fig. 19.)
Some fixtures of this type use silver-bowl bulbs.

Since all light is directed to the ceiling, light-colored ceilings are essential to satisfactory use of indirect fixtures.

Suggested locations: Living room, bedrooms, or any other room where ceiling is light in color.

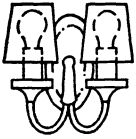
Mounting: Low enough that the circle of light reaches to the walls across the narrow dimension of room, but not less than 6½ feet above the floor. Proportions and general appearance of the room may alter the height at which the fixture is hung.



Metal reflecting bowl. Indirect ceiling fixture.

Attached Lighting Fixtures—Continued

Type of fixture



Shaded candle-type wall bracket.

Description and uses

Diameter: About 4 inches for 40- to 60-watt bulb. Used essentially for decoration; may add to general room illumination, but should not be used for reading, studying, or any close use of the eyes.

Makes the placing of furniture and hanging of pictures difficult. If colored light is desired it should be obtained through the use of a colored shade with a regular inside-frosted bulb.

Suggested location: Where decorative lighting only is desired and where such brackets will not interfere with placing of furniture, as at the fireplace.



Semidirect porcelain wall bracket.

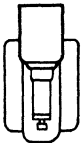
Length: About 8 inches for 40- to 60-watt bulb.

Uses glass or porcelain shade.

Gives semidirect light for specific tasks.

Can be had with outlet for plugging in appliances.

Suggested location: Out of the line of vision; with dense shade may be located about 2 feet above sink, with translucent shade placed at height of window tops. (See fig. 19.)



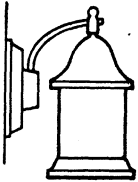
Semi-indirect wall bracket.

Bowl diameter: $3\frac{1}{2}$ inches for 40-watt bulb; 4 inches for 60-watt bulb.

Bowls are usually of opal or frosted glass.

Gives semi-indirect light for specific tasks.

Suggested location: On either side of the bathroom mirror, 5 feet from floor and not less than 30 inches apart if possible.



Weatherproof wall bracket.

Use with 40- to 75-watt bulbs.

For lighting entrance door. It should be located above or to side of door above eye level.

PORTABLE LAMPS

A portable lamp is generally used to provide light for such activities as reading, sewing, and studying. There has been great improvement in lamps of this kind in recent years, and a wide variety has been developed. The Illuminating Engineering Society (I. E. S.) has developed certain specifications for portable lamps that meet specific safety standards and give light of definite requirements as to quality and quantity. The I. E. S. certification tag (fig. 10) indicates that requirements set up by this organization as to construction and performance have been met.

Most portable lamps are designed to give both direct and indirect light—direct light to provide the downward illumination needed for a definite activity; indirect to decrease shadows in the vicinity of the



Figure 10.—Illuminating Engineering Society certification tag

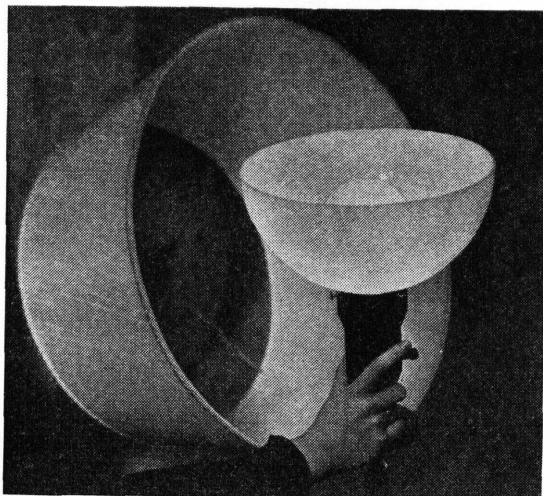


Figure 11.—Portable lamp with shade removed to show diffusing bowl. The two-filament bulb with the mogul socket used in this lamp provides for three intensities of light

worker and reduce the contrast between the brightly lighted area and the rest of the room. In the newer types of lamps the light is softened by passing it through a diffusing bowl of glass or plastic. The open top of this diffusing bowl directs the remaining light to the ceiling for general illumination (fig. 11). Plastic bowls do not break so easily as glass and give good diffusion of light.

The portable lamp must have sufficient height to permit a good spread of light.

Shades wide at the base and slightly tapering toward the top allow a good spread of light so that work being done need not be directly beneath the lamp, and more than one person can use the lamp at the same time.

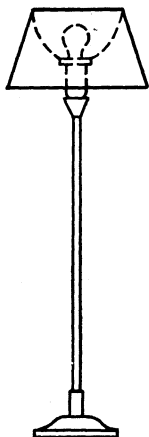
The depth of a shade is important too. It should extend far enough below the bulb or bowl that the light does not shine in the eyes of a person in a normal position for work. Any bulb or bright surface of a lamp in the line of vision may produce uncomfortable glare.

The inner surface of a lamp shade should be light in color so it will reflect light downward rather than absorb it as dark shades do. Shades that permit some light to pass through may be more pleasing in appearance, but they should never be so thin that the light bulb or bowl is visible through the shade.

The wiring and electrical connections of lamps must be of good quality with protection at points of strain or wear to avoid any chance of shock or short circuit.

Portable lamps

Type of lamp



Floor study and reading lamp.³

Description and uses

Bowl diameter: 8 inches for 100-watt bulb; 9 $\frac{3}{8}$ inches for 150-watt, or 2-filament 50-100-150-watt; 10 inches for 2-filament 100-200-300-watt.

Gives semi-indirect light for specific tasks and general room illumination. With careful arrangement of furniture will provide for several persons.

Suggested locations: Beside and slightly to the rear of lounge chairs and davenports, centered behind davenports, at the left or right of desks or tables used for writing or study, and at the piano.

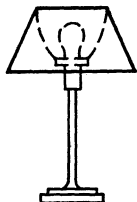
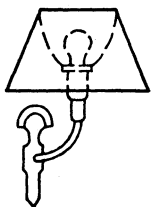


Table study and reading lamp.³

Bowl diameter: 8 inches for 100-watt; 9 $\frac{3}{8}$ inches for 150-watt or 2-filament 50-100-150-watt bulb.

Gives semi-indirect light for desks or tables for reading, writing, studying, or drawing.

Suggested locations: On left-hand or right-hand side of flat-top desk. In center of large table for use by several persons or on table of small diameter with several chairs grouped around it for reading or sewing.



Pin-up bracket lamp.³

Bowl diameter: 6 inches for 75-watt; 8 inches for 100-watt bulb.

Gives semi-indirect light for specific tasks and for decorative lighting. The lamp is hung on small nails driven into the wall and may be placed at any point where light is desired. As there are several styles, a lamp of this type should be chosen with a definite purpose in mind.

Suggested locations: Over beds, sewing machines, chairs, radio, sofa, and small desks against the wall, or in the kitchen over work areas.

Mounting: High enough to shed full light on the work but close enough to give good illumination.

³ Lamps conforming to Illuminating Engineering Society specifications are available in this type.

Portable lamps—Continued

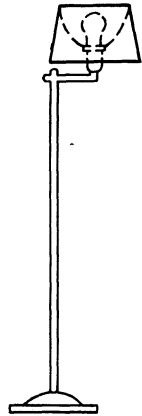
Description and uses

Bowl diameter: 8 inches for 100-watt; 9 $\frac{1}{2}$ inches for 150-watt or 2-filament 50-100-150-watt bulb.

Gives semi-indirect light for specific tasks and for general illumination.

Suggested locations: Beside chairs, small writing desks or tables and where larger lamps are not suitable.

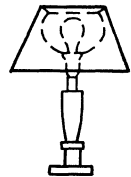
Type of lamp



Bridge lamp.³

Bowl diameter: 8 inches for 100-watt bulb.
Bowls of opal, crystal, or prismatic glass.
Gives semi-indirect light for reading, decorative lighting, and general illumination. If lamps do not carry an I. E. S. certification tag, they should be tall enough and the shade broad enough to light the work being done by a person seated comfortably on chair or sofa.

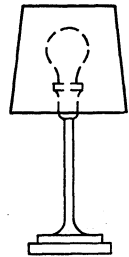
Suggested location: On end table approximately 26 inches high. Should always be placed directly to the side of the chair or sofa.



End-table lamp.³

Uses 60-watt bulb for semidirect light. The material for the shade should be heavy enough to prevent the bulb from showing through. Neutral colors give the most satisfactory results for applying cosmetics.

Suggested location: At either side of mirror on dresser or dressing table. The lamp should be high enough to light the face, but the bulb should not be seen below the shade by the person using the mirror.



Dressing-table lamp.

ELECTRIC-LIGHT BULBS

Although electric-light bulbs may all look very much alike there may be a great difference in quality. It is advisable to buy bulbs produced by reputable manufacturers who conform to Federal specifications for incandescent lamps. When buying bulbs the purchaser should be sure to get those made for the voltage of his electric system (fig. 12). The electrical service supply agency will always tell what voltage is supplied to a house.

³ Lamps conforming to Illuminating Engineering Society specifications are available in this type.

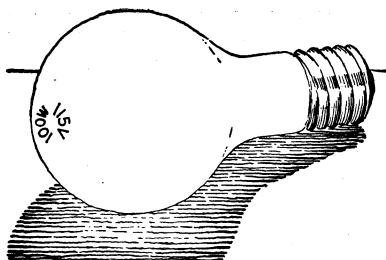


Figure 12.—The end of a light bulb is marked with voltage and wattage

For economy of operation and initial cost of bulbs, one bulb of high wattage will give more light and cost less than several small ones whose combined wattage is the same; that is, a 100-watt bulb furnishes more light than four 25-watt bulbs, costs the same to operate, and the initial price is only one-fourth as much.

Table 1 compares the costs of obtaining an equal amount of light from three different sizes of electric bulbs.

TABLE 1.—*Equal illumination from three sizes of bulbs*

Size of bulb	Number required	Total cost of bulbs	Cost of electricity for 1 hour at 4 cents per kilo-watt-hour	Cost of electricity for 1,000 hours ¹ at 4 cents per kilo-watt-hour
100 watts.....	1	\$0. 15	\$0. 004	\$4
60 watts.....	2	. 30	. 005	5
25 watts.....	6	. 90	. 006	6

¹ Average life of standard bulbs.

Similarly a 200-watt bulb provides more light than two 100-watt bulbs and at less cost.

Bulbs that give the same amount of light may be purchased in either clear or inside-frosted glass. Inside-frosted bulbs give a more diffused light than clear ones but should not be considered a substitute for a diffusion bowl or shade on a lamp. Light from an exposed frosted or clear-glass bulb may cause considerable discomfort if it is within the range of vision.

Silvered-bowl bulbs made by covering the large bowl end of a regular frosted bulb with a coating of "mirror" silver are now available. This coating does not tarnish and makes a reflector of the bowl of the bulb, which must be used bowl end down to provide indirect lighting.

The three-light bulb is another recent arrival in the home-lighting field. Two filaments, each of a different wattage, are used in the bulb. Either one or both may be used at one time, thus making it possible to have three different levels of light from a single bulb, operated by a single switch. These bulbs may be had in 50-100-150- or 100-200-300-watt sizes. These three-way lamp bulbs have a special mogul double-contact base, which requires a special socket larger than that required for the average residential lamp bulb. While the three-light

bulb costs more than the single-filament bulb it has the advantage of greater flexibility and convenience.

The fluorescent lighting unit is another recent development in the lighting industry, and because such units give much more light for the same wattage than ordinary incandescent bulbs, they are likely in the future to be widely used in the home. At present, they are more expensive than regular bulbs. This type of unit requires a special socket and a controlling device called an auxiliary. The fluorescent unit may be obtained in various colors, including daylight.

General lighting

Where general light only is needed it is usually provided by ceiling fixtures. The indirect or semi-indirect fixtures provide good, diffused general illumination. Enclosing globes which give semidirect light reduce glare from bare bulbs and help to distribute light evenly in the room; these are used quite generally in kitchens, bathrooms, halls, laundries, and porches. In order to reduce expense, exposed inside-frosted bulbs may be used in such places as halls, porches, basements, and closets. Portable lamps of the semi-indirect type supply some general illumination and, if used in a small room or if several are in use in a large room, they may supply sufficient general light as well as that needed for specific jobs (fig. 13).

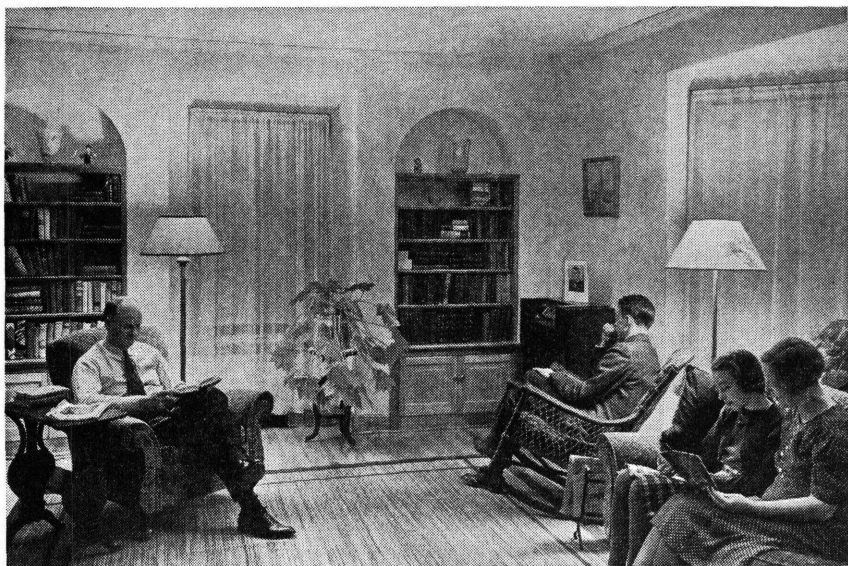


Figure 13.—This living room is entirely lighted by portable lamps with diffusing bowls. Note the evenness of illumination throughout the room. Adequate light is supplied for a number of people to carry on special activities as well as the necessary general illumination. The lamp on the left is a floor study or reading lamp with a 10-inch diffusing bowl using a 100-200-300-watt three-light bulb while that at the end of the sofa has a 9 $\frac{3}{8}$ -inch diffusing bowl with a 150-watt bulb



Figure 14.—This dining-room ceiling fixture gives proper illumination for a variety of activities. Note the placement of the fixture high enough to spread light over the entire table but low enough so that the diffusing bowl is not visible to the eye. Also observe the man's position which allows the light to fall directly on the paper. This fixture has a 10-inch diffusing bowl and a parchment-paper shade and uses a 150-watt bulb

Light for close seeing

Reading, writing, studying, sewing, and needlework all involve close seeing, often for long periods. The habits of the family will determine where lights must be located to provide the necessary illumination. If the kitchen is used for sewing or by the children for studying, a good lamp is as important there as in the living room.

Careful planning makes it possible to group activities so that a few good lamps may serve the whole family. For example, a floor lamp of adequate height and with a wide shade to give a good spread of light may serve one person who is sewing and one or two more who are reading. The usual type of bridge lamp has a rather narrow shade so that ordinarily only one person can properly use its circle of light. A table or study lamp may supply good light for several persons if placed on a table small enough and high enough to light a wide circle. End-table lamps of good height and shade spread may be used by one or two persons. Pin-up wall lamps also are good

over davenport or chairs that are placed close to the wall. The lamp should be hung low enough to light the work properly. Because these lamps are close to the wall and the shades are often not very wide, they can be used by only one or two persons.

Ceiling fixtures do not usually supply enough light for most close-seeing activities, although some semi-indirect fixtures that are hung quite low provide sufficient light for ordinary reading and writing or sewing on light cloth. An example of this is the semi-indirect dining-room fixture (fig. 14). Such a fixture should, if possible, be hung high enough so that the entire table top is lighted, but low enough so that no appreciable part of the diffusing bowl is visible to those seated at the table.

READING, WRITING, AND STUDYING

For ordinary reading and studying, properly designed floor, bridge table-study, and end-table lamps all provide satisfactory light.

If the print is clear and reasonably large a 100-watt bulb in a table-study or end-table lamp with an 8-inch diffusing bowl will usually supply adequate illumination. If the print is fine or not sharp and clear a lamp with a 9 $\frac{1}{2}$ -inch diffusing bowl and a 150-watt bulb is recommended.

Since the light source of floor lamps is farther from the page, higher wattage bulbs must be used. For ordinary reading, floor lamps using 9 $\frac{1}{2}$ -inch diffusing bowls and 150-watt bulbs may be satisfactory while for fine print those with 10-inch diffusing bowls, which will accommodate either 200- or 300-watt bulbs or two-filament 100-200-300-watt bulbs, are suggested.

The pin-up wall lamp is especially adaptable for reading in bed (fig. 8). It can usually be hung low so that the light source is closer to the page than is the case with other types of lamps. One with a 6-inch diffusing bowl and a 75-watt bulb is usually satisfactory. If the lamp must be placed fairly high on the wall one with an 8-inch bowl and a 100-watt bulb is better. There should be no shadow on the page, and the best position for the lamp is to one side and slightly back of the reader so that the light comes over the shoulder (fig. 15).

When writing, the shadow from the hand should not be in the path of the pencil or pen (fig. 16). Therefore the light should come from the left for a right-handed person and from the right for a left-handed person. Since the illumination decreases very rapidly as the distance of the source of light from the work increases the lamp should be as close to the work as is comfortable. If the worker must face the lamp the eyes should be carefully protected from the direct rays of light (fig. 6).

When a table or study lamp is used, care must be taken that it is high enough to light the whole table or desk surface and is properly shaded so that the bulb or diffusing bowl is not a source of annoyance to the user. These points are especially important if the lamp is placed in the center of the dining table to provide light for several children when they are studying (fig. 14).

Reflected glare from table top or paper should be avoided. A shiny table or desk top may reflect light to the eyes. If so, a blotter or dull-textured cloth spread over the desk will aid in eliminating such reflection.

Good desk or study lamps are most desirable for writing, although floor lamps and portable wall lamps (fig. 6) are good if they are well placed and are especially useful when desk space is limited. Table lamps with 8-inch diffusing bowls and 100-watt bulbs usually provide adequate illumination for ordinary writing. If writing is usually prolonged or is especially fine in character, lamps with larger bulbs may be desirable. Ceiling fixtures that hang rather low as, for instance, over a dining table (fig. 14) may provide good light for writing. A desk that is used during the day as well as at night should be placed by a window in such a position that daylight also will fall upon the work from the correct side (fig. 16).

The study lamp (fig. 5) provides no general illumination but directs the undiffused light onto the book or paper where it is very apt to cause reflected glare. This bright spot of light in an otherwise dark

Figure 15.—Lamps placed back and slightly to one side of the reader prevent shadows from falling on the page. Note the grouping of furniture so that more than one activity can be carried on about a lamp. The man on the sofa is reading by the light of an end-table lamp which has an 8-inch prismatic glass bowl and uses a 100-watt bulb. The other lamp is a table-study or reading lamp with a 9 $\frac{3}{8}$ -inch diffusing bowl and uses a 150-watt bulb



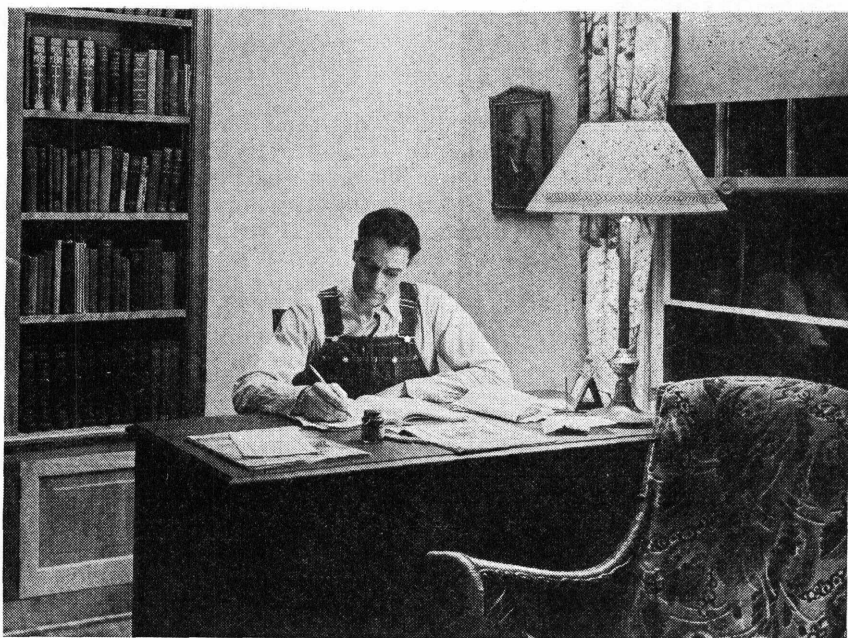


Figure 16.—This table study lamp with an 8-inch bowl and a 100-watt bulb supplies adequate light for comfortable writing. Note the placement of the desk to utilize daylight whenever possible

room may be extremely trying to the eyes, and this type of lamp is not recommended.

SEWING

Sewing requires more light than any other usual home activity because thread ordinarily matches the material and stitches are often fine. For ordinary sewing on light material lamps of the types described under Reading, Writing, and Studying, are satisfactory. While it is possible that lamps with 100-watt bulbs and 8-inch diffusing bowls may provide adequate illumination, those with 9 $\frac{1}{2}$ - or 10-inch bowls and higher wattage bulbs are recommended. Sewing over long periods, or on very fine needlework or on dark materials requires much lighter illumination and should be done by daylight near a window if possible (fig. 17). When sewing is done by artificial light, the lamp should be placed either to the right or the left of the sewer, depending on which hand holds the needle. There should be no shadow on the work.

Modern sewing machines frequently have small lights that illuminate the spot where stitching is done, but in addition there should always be some other source of light such as a good ceiling fixture or a well-placed table or floor lamp.



Figure 17.—Furniture is placed to make use of daylight when possible, but artificial light is readily available

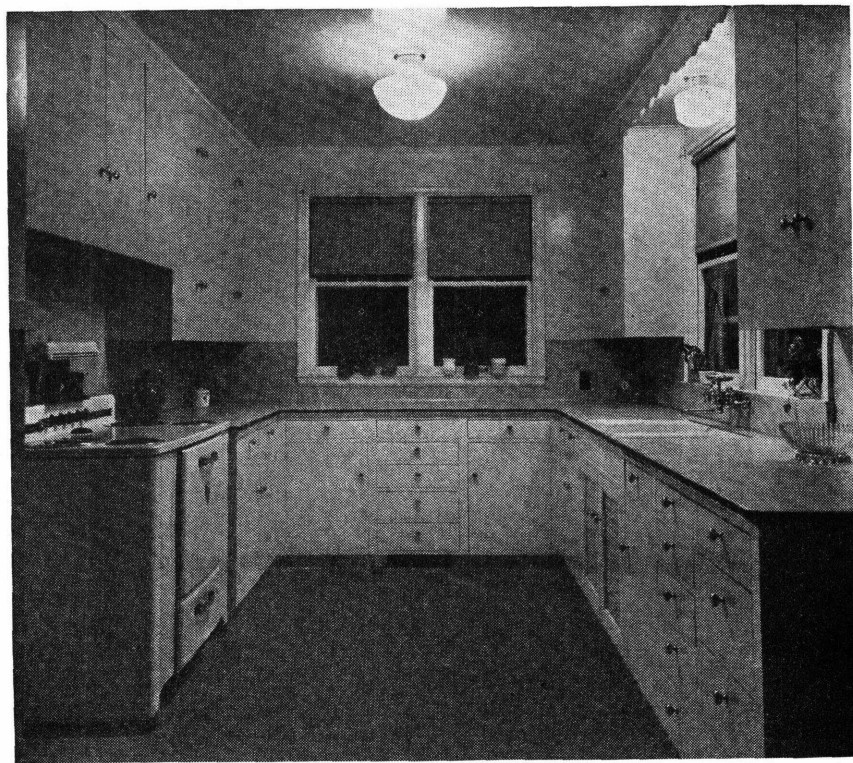


Figure 18.—Enclosing globes give diffused light and provide general illumination for this Wisconsin farm kitchen. The center fixture is a 10-inch enclosing globe with a 100-watt bulb, while that over the sink is an 8-inch globe with a 60-watt bulb to supply light for tasks requiring additional light

KITCHEN AND LAUNDRY WORK

At certain points in the kitchen such as the sink, range, and work table where tasks that require moderately close seeing are performed, local lighting is desirable in addition to general lighting (figs. 18 and 19). If the kitchen is small, a good central fixture without additional local lighting may be sufficient.

Figure 19.—This indirect ceiling fixture uses a 200-watt silver-bowl bulb and gives evenly distributed light throughout the room. Note the bracket light with a 60-watt bulb which provides additional light over the sink



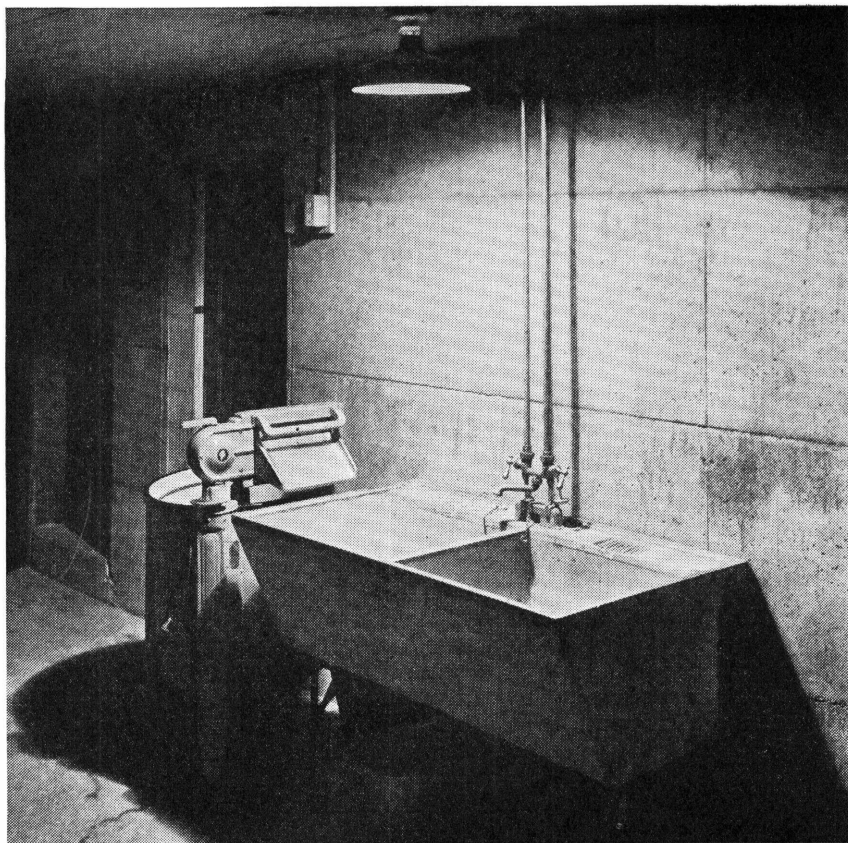


Figure 20.—An R. L. M. dome reflector with a white porcelain enamel lining provides good light for basement rooms in which the ceilings are dark. Note placement of fixture directly above the tubs to eliminate shadows. The fixture shown is a 12-inch size using a 100-watt bulb

Lights are often required over the tubs and washing machine. A ceiling fixture with a glass enclosing globe is good; or if the ceiling is dark, a fixture with a white-lined dome reflector (fig. 20) may be used. There should also be a light over the ironing board.

Light for special purposes

USE OF MIRROR

For shaving, applying cosmetics, and dressing the hair (fig. 21) the face, not the mirror, should be lighted, and there should be good light on both sides of the face. Two fixtures with 40- or 60-watt bulbs, well-shaded, one on either side of the mirror, provide the best light. If placed 30 inches apart, 5 feet from the floor, neither light will be in the direct line of vision when looking into the mirror.

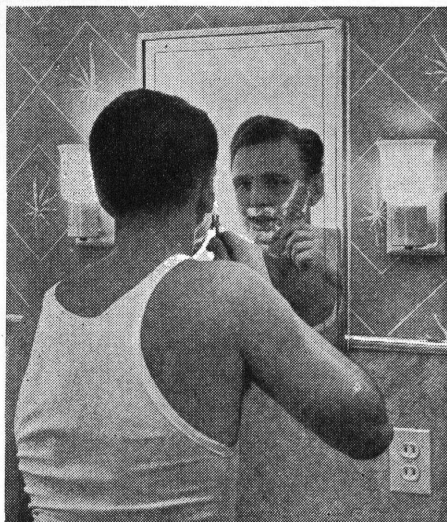


Figure 21.—Brackets with opal-glass bowls on each side of the bathroom mirror provide good light for shaving; 3½-inch bowls are shown in which 40-watt bulbs are used



Figure 22.—Good lighting on both sides of the face is provided by these vanity lamps. Note that the lamps are of the correct height to direct diffused light onto the face. Thin parchment-paper shades are used on these lamps with 60-watt bulbs to provide the necessary illumination

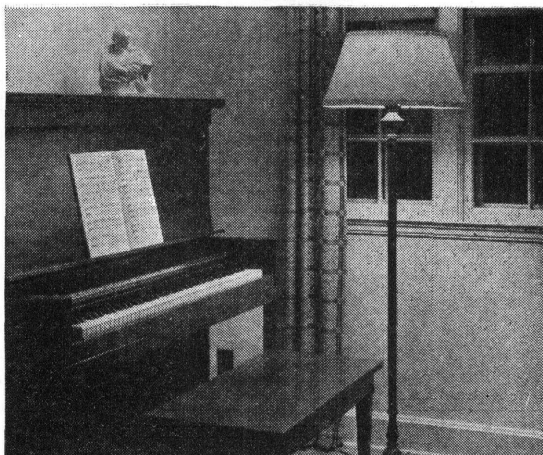
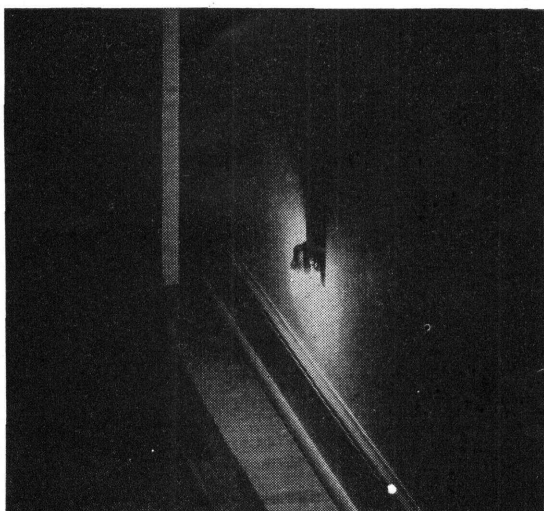


Figure 23.—This floor lamp with a 10-inch diffusing bowl and 100-200-300-watt three-light bulb provides good light without glare on the music as well as general illumination for this end of the room. The position of the piano for daylight use is also good

A single overhead light mounted above the mirror may serve the purpose, although it does not give as good light under the chin and on the neck as do two side lights. A ceiling fixture provided with a diffusing bowl or enclosing globe and placed over the mirror about 12

Figure 24.—Night light in use



inches from the wall provides reasonably good illumination at the mirror as well as general light for the room.

Bracket lamps or tall vanity lamps may be used for the mirror in the bedroom. They should be shaded to diffuse the light and to prevent it from shining in the eyes. White or neutral-colored shades are the most satisfactory, especially where the lamps are used in applying cosmetics (fig. 22).

PLAYING MUSICAL INSTRUMENTS

The same sort of lighting is needed for the page of notes when playing a musical instrument as for reading a book. The lamp is best located back and to one side of the player (fig. 23). If a lamp is used to light the page directly, there should also be sufficient general illumination in the room so that there are no sharp contrasts of light and dark.

NIGHT LIGHT

A small night light that can be plugged into ordinary convenience outlets will provide enough illumination for a person to see his way about but will not be enough to waken sleepers (fig. 24). The night light may be located near the floor at the head of the bed, with its seven-watt bulb throwing a path of light along the floor, or it may be used in the hallway.

Remodeling old lighting installations and equipment

■ WHERE the lighting system does not provide enough outlets there are a number of ways to improve it, if the wiring in the existing circuits is of sufficient size to take care of the additional load. This should be determined by a reliable electrician before additional outlets are installed. Single convenience outlets can be replaced by double or triple ones (fig. 7). In some instances a convenience outlet can be installed beside an existing wall switch with little trouble or expense. Surface-wiring systems may be applied, which extend existing systems without the necessity of cutting into partitions or walls. These additional outlets add to the flexibility of use of lamps or appliances throughout the room.

If the budget does not allow for the installation of wall switches, a cord attached to the pull chain of the fixtures may be used. This should be carried across the ceiling and dropped through a screw eye by the side of the door. This provides for the turning on and off of the light upon entering and leaving the room rather than groping in the dark for the pull chain.

Old fixtures and lamps in the home may often be modernized effectively and inexpensively. Bare bulbs and fixtures may be covered with shades to prevent glare and diffuse the light. Bulbs of sufficient size to give adequate illumination may be used comfortably when shaded. Inverted cones and plastic bowls (fig. 25, *A* and *B*) make attractive diffusing shades for shower-type fixtures. Small candle shades (fig. 25, *C*) fitted to individual bulbs give more light directly beneath the fixture than do parchment cones, but the quality of the light is not so good.

Adapter-type units of glass, metal and plastic (fig. 25, *D*, *E*, and *G*) may be used to shade bare bulbs on single-socket ceiling fixtures.

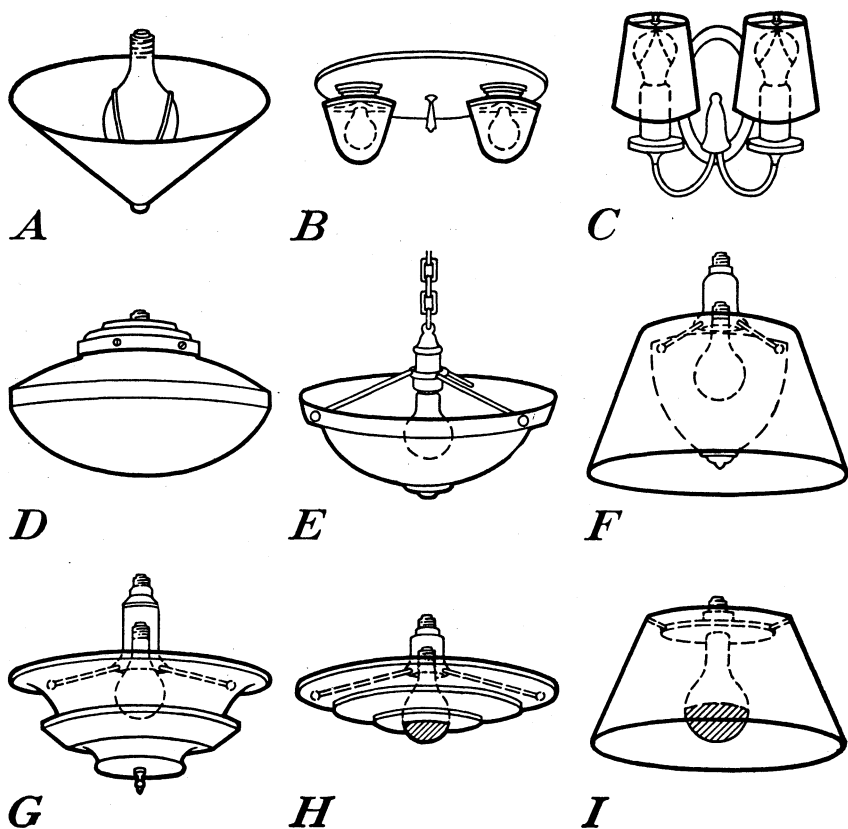


Figure 25.—A and B, small parchment cones and plastic and metal bowls suitable for shading bare bulbs on shower-type fixtures; C, parchment or plastic cylinders to be used on candle-type fixtures; D, semidirect enclosing-globe adapter of opal glass; E, semi-indirect plastic or glass diffusion bowl; F, semi-indirect adapter with plastic diffusion bowl and parchment shade; G, totally indirect metal adapter; H, totally indirect metal adapter using silvered-bowl bulb (see fig. 19); I, parchment bridge adapter using silvered-bowl bulb

Adapter-type units (fig. 25, *H*) made for silvered-bowl lamps may be used in living room, dining room, or bedrooms.

Enclosing globes (figs. 18, and 25, *D*) may be used instead of bare bulbs in kitchen, bathroom, or porch.

A floor or table lamp that does not give adequate light may be improved considerably by replacing the old socket with an adapter socket and diffusing bowl, and by replacing a dark shade with one of good shape lined with white (fig. 11). Care must be used, however, in the selection of adapter equipment so that the remodeled lamp will not be top-heavy.

A bridge-type lamp can sometimes be improved by inverting the socket and adding a diffusing bowl, or by using a special shade with adapter (fig. 25, *I*).

If there is any question about the results of remodeling or if the improvement cannot be made inexpensively, it is better to spend a little more and buy a new lamp that will measure up to the standards for good lamps. (See pp. 19 and 23.)

Upkeep of lamps and bulbs

Electric lamps do not demand such frequent care as oil lamps and lanterns, but they should have occasional attention if they are to continue to deliver all the light of which they are capable. A coating of dust on an electric bulb reduces its efficiency just as soot on the chimney reduces light from an oil lamp. Light bulbs, shades, and diffusing or reflecting bowls should be kept clean. Light bulbs should be wiped off with a damp cloth but should not be completely immersed in water; it is best for the base of the bulb to remain dry.

Cost of light

The value of good lighting cannot be measured in dollars and cents. Protection to eyes and nerves and added beauty for the home are the result of well-planned and properly maintained lighting systems.

Many people do not have the proper amount of lighting because they feel that the cost will be too great. Oftentimes, however, the difference in cost between good and poor lighting is much less than people think. If the actual cost were known, they would not hesitate to provide the additional wattage necessary to obtain adequate light.

Table 2 provides a basis for estimating the cost of electricity for lighting.

Determine your lighting needs by use of the planning chart (p. 41). Add the wattage of the bulbs necessary to provide the proper illumination as recommended by the Rural Electrification Administration's representative or electrical service supply agency. Select the line by this total (table 2) and follow it across to the column headed by the rate you will pay for electricity in your locality.

If you already have electricity and plan to add lighting fixtures or increase the wattage of the bulbs in your present lamps and fixtures, add only the wattage of the bulbs which must be added to provide adequate illumination.

TABLE 2.—*Cost per hour of electric energy for various wattages and stated rates per kilowatt-hour*

Wattage	Cost per hour when the cost of electric energy per kilowatt-hour is—					Wattage	Cost per hour when the cost of electric energy per kilowatt-hour is—				
	2 cents	4 cents	6 cents	8 cents	10 cents		2 cents	4 cents	6 cents	8 cents	10 cents
	<i>Cents</i>	<i>Cents</i>	<i>Cents</i>	<i>Cents</i>	<i>Cents</i>		<i>Cents</i>	<i>Cents</i>	<i>Cents</i>	<i>Cents</i>	<i>Cents</i>
5.....	0.01	0.02	0.03	0.04	0.05	150.....	0.30	0.60	0.90	1.20	1.50
10.....	.02	.04	.06	.08	.10	200.....	.40	.80	1.20	1.60	2.00
15.....	.03	.06	.09	.12	.15	250.....	.50	1.00	1.50	2.00	2.50
20.....	.04	.08	.12	.16	.20	300.....	.60	1.20	1.80	2.40	3.00
25.....	.05	.10	.15	.20	.25	400.....	.80	1.60	2.40	3.20	4.00
30.....	.06	.12	.18	.24	.30	500.....	1.00	2.00	3.00	4.00	5.00
40.....	.08	.16	.24	.32	.40	600.....	1.20	2.40	3.60	4.80	6.00
50.....	.10	.20	.30	.40	.50	700.....	1.40	2.80	4.20	5.60	7.00
60.....	.12	.24	.36	.48	.60	800.....	1.60	3.20	4.80	6.40	8.00
75.....	.15	.30	.45	.60	.75	900.....	1.80	3.60	5.40	7.20	9.00
100.....	.20	.40	.60	.80	1.00	1,000.....	2.00	4.00	6.00	8.00	10.00

EXAMPLE: The Smith family at present is using 100 watts for lighting their living room and their electric rate is 4 cents per kilowatt-hour. They anticipate adding a three-light floor lamp (300 watts) which will increase their wattage to 400 watts. If they use the additional lights an average of 2 hours per day or 60 hours per month, the increased cost will be 60 times 0.012, or 72 cents per month. The calculation for this is as follows:

$$\frac{300 \times 60}{1,000} \times .04 = 0.72$$

PLANNING CHART

Table 3 shows the possible activities carried on in the different rooms of the house. The lighting which must be provided to care for the actual activities carried on by the family in each room will depend on the number of activities which can be carried on about each light source at the same time. This will in turn depend on the number of persons using the room and the grouping of the furniture. For example, it might be possible for a family of five to carry on five different activities at the same time with two portable lamps by properly grouping the furniture around these two light sources.

In the column headed "Actual activities" group together the actual activities which in your home can be carried on around one lamp. The number of groups will determine the number of lamps which you will need for each room. For the proper type lamp for each activity, see page 23.

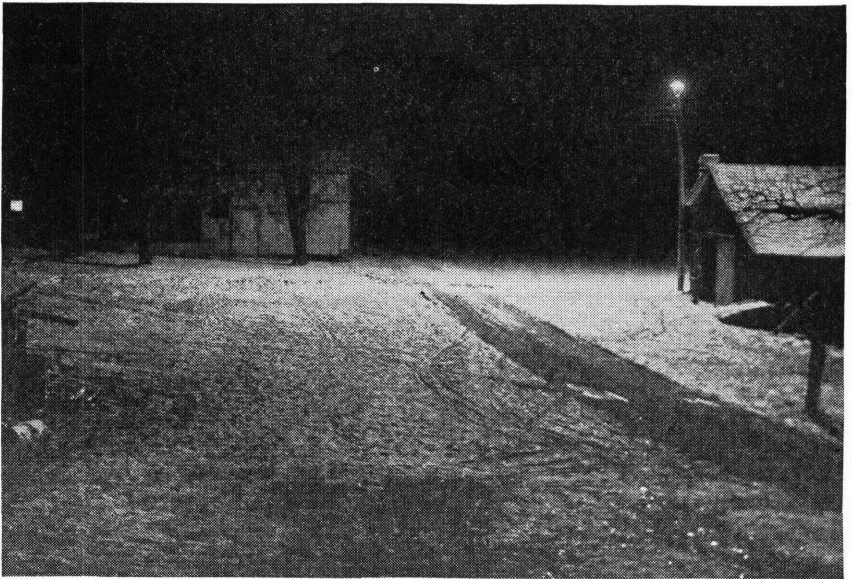
TABLE 3.—*Lamps needed to provide adequate light in different rooms*

Room	Possible activities	Actual activities	Number of lamps needed	Average lighting requirements
Living room	Sewing, reading, studying, writing, playing piano, playing table games, and general activities.			In general 2 or 3 good portable lamps or 2 portable lamps and 1 ceiling fixture will provide sufficient light for general illumination and for the activities of the average family.
Dining room	Activities at table: Dining, eating, reading, studying, writing, playing games, and sewing. Activities at other centers: Sewing at machine, writing at desk, and general lighting.			A combination (semi-indirect) ceiling fixture with a 3-intensity bulb (100-200-300-watt) or 1 table lamp will provide adequate light for activities carried on at the table and general illumination.
Kitchen	Preparing food, cooking and serving food, washing and drying dishes, planning menus, and general activities.			1 or more portable lamps depending on the number of other activity centers in the room.
Bedroom	Reading in bed, using mirror, sewing, reading in chair, working at desk, and general lighting.			1 ceiling fixture supplemented by 1 or more bracket lights at sink and work table. It may also be highly desirable to provide a bracket lamp at the range if the kitchen is large.
Closet	General lighting			1 ceiling fixture, supplemented, if necessary, by 1 or more portable lamps, is generally sufficient to provide light for the bedrooms.
Bathroom	Using mirror, general lighting.			The following portable lamps may be desirable: 1 pin-up lamp over each bed, or 1 table or floor lamp between 2 beds for reading, 2 dressing-table lamps for lighting mirror, and a floor lamp for other activities. General illumination is provided by the ceiling fixture.
Hall and stairway	General lighting			1 ceiling fixture or wall bracket.
Laundry	Ironing, washing, and general lighting.			1 ceiling fixture and 1 bracket light over mirror or 1 bracket light on either side of mirror should be sufficient for using mirror and providing general illumination.
Basement	Laundry, canning, storage, furnace, and general lighting.			1 ceiling fixture and 1 or 2 supplementary fixtures, such as bracket lights, for the activity centers. 1 ceiling fixture or wall bracket for each room or activity center, and 1 ceiling fixture at stairway.

Yard lighting

■ Lights in the farmyard are a great aid in getting about and doing chores before sunup and after sundown during the winter months (fig. 26). Switch control both at the house and in the yard add greatly to convenience and safety. Light in and around buildings is

Figure 26.—A well-placed light for the paths from house to barn and other buildings



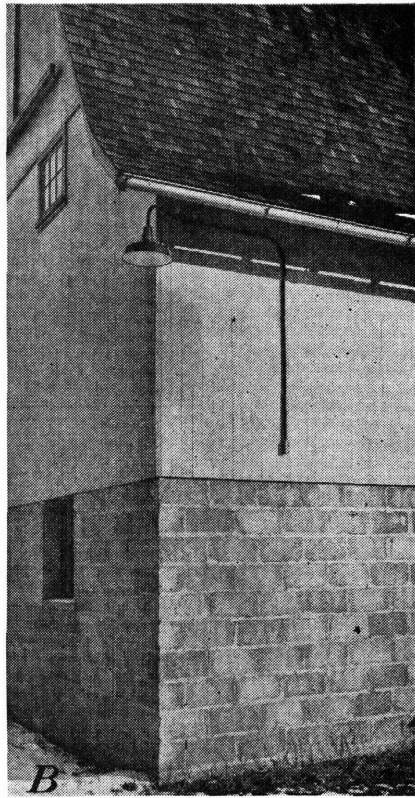
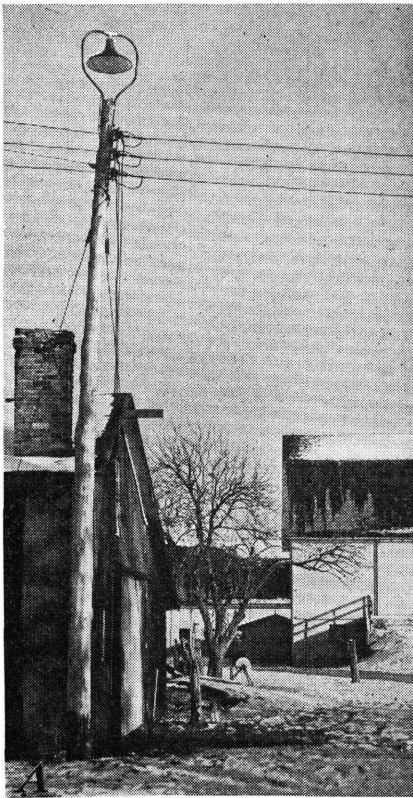


Figure 27.—Yard lights: A, mounted on pole with arch-type holder; B, mounted on corner of barn with bracket formed by bending the conduit. Brackets can be purchased complete with reflector and base for attaching to building or pole

important when there are sick or injured animals to care for, or in case of fire, and to discover prowlers. Outdoor lighting near the house gives opportunity for evening games and parties.

One or more of the poles that carry the wiring system may also serve as supports for yard lights. The electric-meter support may make a convenient location for the principal yard light. Fifteen feet or more above the ground is the recommended height for a light in order to remove direct rays from the ordinary line of sight and to scatter the light over a wide area. If lighting units are placed higher, light is spread more widely, shadows are shortened, and fewer units may be necessary. If possible, a location for the yard light should be found that will enable it to light the house entrance and all the paths between the house and other buildings. On the yard pole a bracket-type holder (fig. 27, A) may be used, although the arch-type holder is more rigid and eliminates the shadow of the pole. If a light pole is not convenient, lights may be placed on the silo or other farm buildings

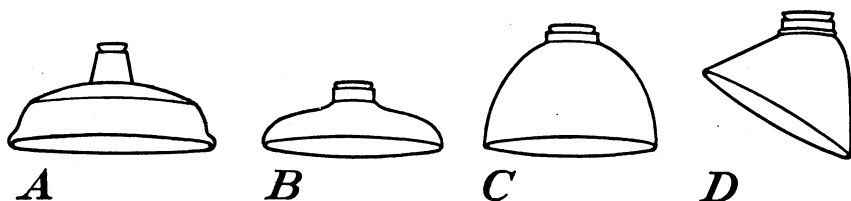


Figure 28.—Reflectors for yard and outbuildings: A, R. L. M. or deep-dome reflector; B, shallow-dome reflector; C, bowl reflector; D, angle reflector

(fig. 27, *B*). In deciding which to use the comparative cost of installation and the ease of replacing lamps as well as the size and location of the area to be lighted must be considered.

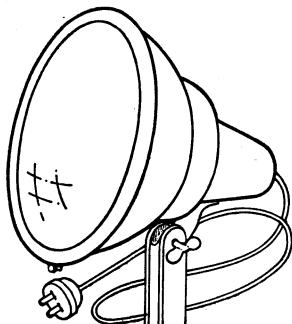
Reflectors serve to direct the light to the ground. Flood lights and angle reflectors are also used to direct the light toward buildings or areas that may require protection against marauders. For such cases it is best to mount lighting units high to reduce shadows. Shallow-dome (fig. 28) reflectors are used where a widely lighted area is desired and the recommended mounting heights are not possible.

All outdoor lights should be equipped with weatherproof reflectors and porcelain lamp holders to prevent water from getting into the socket and to reduce possible breakage of bulbs from rain or hail. Reflectors are usually made of metal with white porcelain inside finished or of aluminum with polished or oxidized inside finish.

As a rule, lamps of at least 200-watt size are needed for use outdoors. In selecting reflectors allowance should be made for using larger lamps later if experience should show the need for them.

Special stock and feeding areas outside the barns may need individual lighting. Bracket holders with R. L. M. or angle reflectors (fig. 28) on the side or corner of the barn, or a lighting unit on a pole may be used. Special flood lights, or projector (fig. 29) reflector types of bulbs may be used for many special applications, such as silo filling, sorting fruits and vegetables, loading trucks, etc.

Figure 29.—Flood light



The flood light is particularly adapted for emergency jobs at night because the light can be projected for relatively long distances.

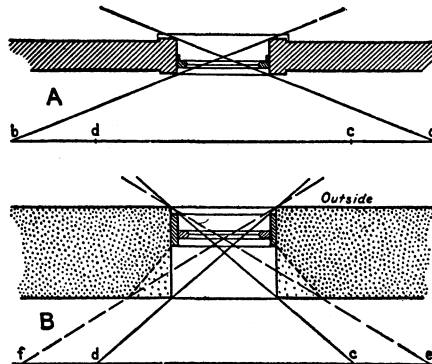
Buildings and fences painted with a light color help the general illumination by reflecting light and enable one to see objects silhouetted against them; dark-colored buildings absorb light. Trees and shrubbery may both obstruct and absorb light. Yard space that is much broken up by buildings or trees may require two or more lighting units for adequate coverage.

Lighting the farm buildings

Natural light

■ Light in farm buildings is needed for safety, convenience, and health, and to promote cleanliness. Cleanliness is much easier to obtain when there is light enough to see dirt which may harbor disease-producing bacteria. For dairy stables with windows well arranged to catch the sunlight, many sanitary regulations require 4 square feet of glass per cow or 1 square foot of glass per 20 to 25 square feet of floor area. A larger area of glass than this allows rapid lowering of temperatures in cold weather and undesirable heating on hot days. In

Figure 30.—Effect of wall thickness on light distribution: A, plan of a window in a frame wall facing south, 9 inches thick at the jamb. B, window of same width in a 22-inch masonry wall



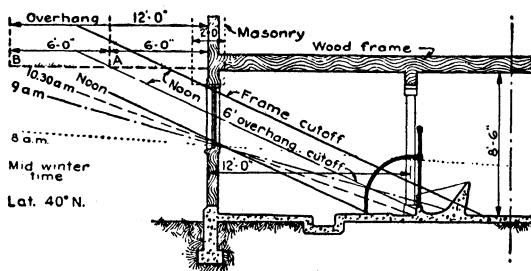


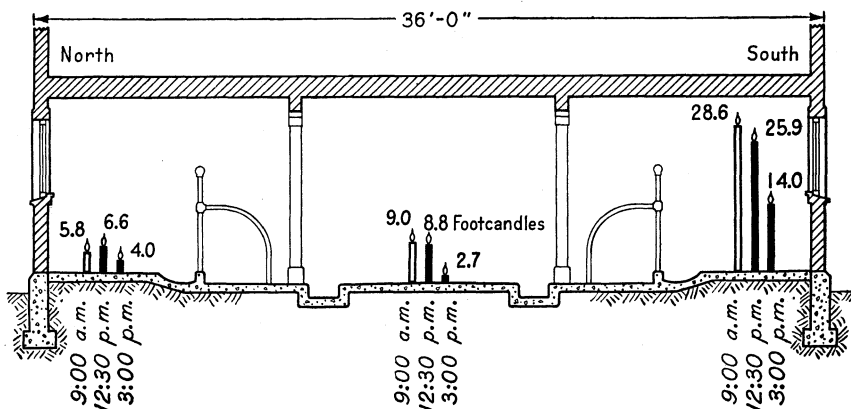
Figure 31.—One-half cross section of a dairy stable 36 feet wide showing direction of sun's rays at various morning hours and the extent which an overhang may obstruct entrance of sunlight

northern climates the area is sometimes reduced to 3 square feet per cow. Dirt on windows obstructs light, hence windows should be cleaned frequently, especially milk-house and dairy-stable windows.

Thick walls cut off some of the rays of sunlight that enter the windows (fig. 30). Beveling the jambs of the windows (fig. 31) allows more of the direct sunlight to enter. Windows in a stable should be so placed as to give the best general distribution of light throughout the stables. The distribution of light across a dairy stable is shown diagrammatically in figure 32.

To permit the light to penetrate a good distance there should be no shading of windows by overhanging eaves or other construction; the higher the windows the farther the daylight can penetrate and the greater will be its effectiveness in lighting the stable. Light-colored walls and ceilings increase the effectiveness of the light. Whitewashing aids greatly in making a brighter and cleaner stable.

Figure 32.—Distribution of footcandles of light across a dairy stable on a bright December day



Artificial light

Work for which artificial light is needed in and around farm buildings may be divided into three classes: (1) Regular chores, such as feeding, cleaning stables, etc., which do not require close visual inspection; (2) regular chores, such as washing milk utensils, where plenty of light is needed to permit inspection for cleanliness; and (3) seasonal, irregular, or emergency jobs, such as grading fruit or vegetables, care of sick animals, repair of machinery, and the like, where good lighting is needed for relatively short times. Electric light is very convenient and satisfactory for all of these purposes. Where light is needed every day, as is the case for the first two types of work mentioned, lamps should be installed in fixtures. Where light is needed only occasionally it may be supplied conveniently by portable lamps attached to extension cords. Convenience outlets for plugging in these cords should be provided when the wiring for the fixed lights is installed.

The same general fundamentals of lighting apply to the farm buildings as to the farmhouse. The first essential of light in the barn is that a person may see to move safely through the building or loft without stumbling over objects that may be in the way. The second essential is that animals should not be unnecessarily alarmed by moving shadows, with attendant risk of accidents or impaired production. Adequate, well-distributed general lighting, including lamps with reflectors at cross alleys, hay chutes, ladders, and stairways, is needed to meet these primary requirements.

Wiring

When selecting and installing electric wiring in barns and other service buildings, the precautions discussed on page 14 in connection with the wiring of dwellings should be observed. Additional precautions are necessary in buildings for livestock, because of the presence of moisture and corrosive gases such as ammonia and hydrogen sulfide. Fumes and moisture are particularly destructive in the northern climates where stock are closely housed; hence, the importance of using noncorrosive fixtures, boxes, switches, and other wiring materials. Porcelain, or moulded compounds supply this protection. Pull chains for switches should be avoided. If they must be used be sure they have insulated links to minimize possible shocks. As in house lighting, equipment should be kept in good order to give the best service. Fixtures and switches must be kept tight, screws in place, bare wires not exposed, and proper grounding of wires maintained for continuous safe operation. To avoid electrical short circuits because of moisture no light sockets should be left empty.

Dark-colored walls and ceilings, and exposed joists, beams, posts, and girders absorb or obstruct the light and make it necessary to use care in selecting locations for lamps.

Lamps in many farm buildings should be provided with good reflectors which direct the light beams downward and increase the amount



Figure 33.—A well-lighted general barn, showing well-spaced fixtures equipped with reflectors

utilized as well as decrease the glare (fig. 33). Inside-frosted bulbs should be used. Since lights in farm buildings are used for only comparatively short periods there is little saving in using small bulbs.

Planning lighting for farm buildings

■ Little or no factual data are available to show the economic limits of illumination in farm buildings. The recommendations made on the following pages are based on observations and records, and it is believed will result in adequate illumination for the performance of chores.

Dairy barn

The lighting problem in the dairy stable is similar in many respects to that in other farm stables. However, because of the need of cleanliness in the production of sanitary milk and in maintaining the health of the animals and reducing bacterial count in milk, good illumination is of prime importance in the dairy barn. Cleaning and washing udders and checking foremilk for presence of garget are duties requiring more light than for feeding. Current is also needed at times for heat lamps for treating udder troubles. Outlets are required for the operation of portable milkers, clippers, and other electrical devices.

In an ordinary dairy stable mounting lamps at the ceiling and not farther apart than $1\frac{1}{2}$ times their height above the floor would space the light fixtures from 10 to 12 feet apart, that is, 1 light at every third stall. With 60- to 100-watt bulbs in these fixtures, the resultant illumination should be satisfactory. In general, with cows facing in or out a row of lights in each litter alley spaced not more than three stalls apart is recommended. Lights in the feed alley may be spaced somewhat farther apart unless light is needed for weighing feed (fig. 34). If it is not possible to install all lights at one time, those over the litter alleys should have preference.

In buildings where livestock is displayed for sale, it may be desirable to space fixtures every three stalls apart with bulbs of 100 watts or more. In well-finished interiors, enclosing globes instead of the regulation reflectors may be used to give a more cheerful appearance.



Figure 34.—Three rows of lamps provide ample light in this stable. Note how reflectors minimize glare and utilize the light effectively

Recommendations for lighting of calf, hospital, and bull pens are given under Beef Cattle Barns.

Milk house

Good light in the milkroom (fig. 35) and washrooms promotes the cleanliness so important in producing high-quality milk of low bacteria count. In a small room a single 100-watt, inside-frosted bulb in an enclosing globe or reflector mounted at the ceiling and placed over the sink will provide good illumination for careful inspection of glassware and utensils. In larger rooms, two or more lighting units may be necessary for general lighting. Work areas may require special lighting as discussed above.

Beef cattle barns

The principal requirement for light in the beef cattle barn is for feeding. In cattle sheds or loose-stock pens general illumination in feed alleys is desired for safety at intersections, hay chutes, and ladders. At these points a 60-watt or larger bulb should be placed at the ceiling. An R. L. M. reflector may be used.

In general, at least one lighting unit is necessary for each maternity, calf, hospital, or bull pen (fig. 33). Convenience outlets for grooming

devices, insect killers, heat lamps, and other electrical appliances should be installed where most needed. If ultraviolet lamps are to be used, consideration should be given to the size of wiring and other factors that may cause loss of line voltage.

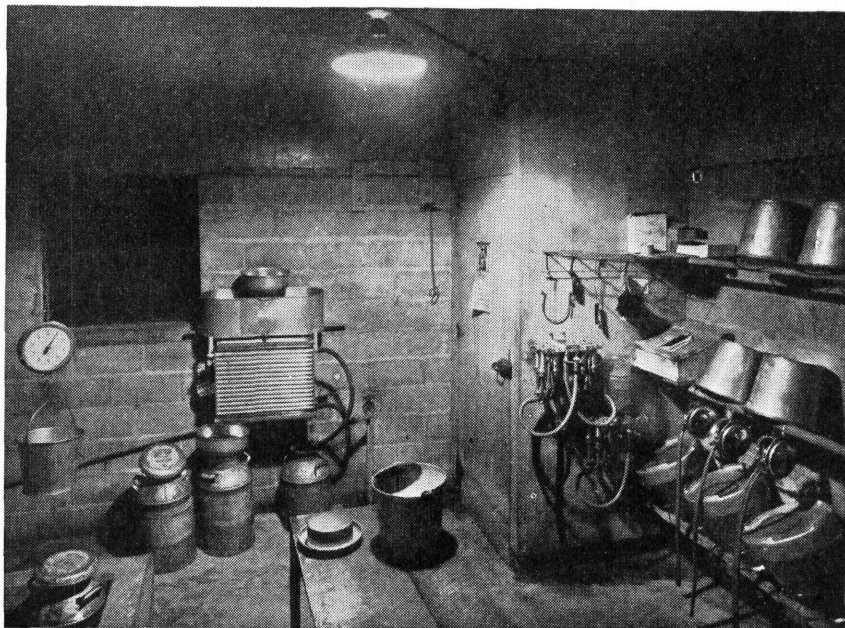
Horse stable

There should be sufficient light in the horse stable so that a horse is not surprised by being approached suddenly; many a docile horse has kicked his master when startled. With stalls on either side of a central alley, one inside-frosted bulb of 60 watts or more in a porcelain reflector (fig. 36) may be used for each team or for every other single-tie stall with conveniently located lights in the feed alley. A single guarded light of 60 watts or more mounted at the ceiling is needed for each pair of box stalls. Additional lights for grooming, exercising, or harnessing spaces may be installed where needed.

Sheep barn

In sheep barns 30 to 32 feet wide a single row of lights, centrally located, will usually be sufficient. In barns 36 feet or more in width two or more rows will be needed. If the beams and cross beams mark

Figure 35.—Cleanliness of milk room and utensils is largely dependent upon ample lighting



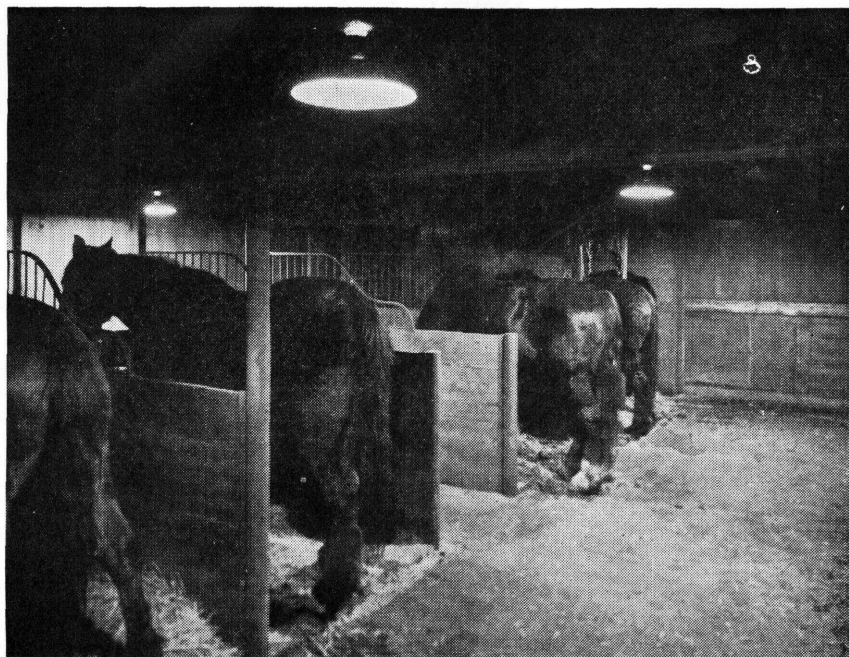


Figure 36.—A well-lighted horse stable using reflectors mounted at the ceiling. Note that lights are in line with stall partitions to minimize shadows

off the ceiling into sections or bays, these may be well lighted by one unit with a reflector mounted at the ceiling in the center of each bay (fig. 37). A 60-watt bulb will be suitable for sections approximately 12 feet square.

A 100-watt bulb and reflector at the ceiling will usually give the desired amount of light in a small shepherd's room. There should be an outlet for an extension cord for emergencies and special work. On the shearing floor at least one 100-watt bulb mounted in an R. L. M. reflector at the ceiling is needed near outlet for each clipper.

Hog house

Light is needed in the hog house mainly for feeding and cleaning. In the usual low-roof type of structure, lamps equipped with reflectors mounted as high as is practicable along the center alley give good lighting. Sixty-watt lamps may be located over each pair of pens. If a single pen extends more than 8 feet, one unit per pen may be used. In hog houses having a single row of pens, light fixtures may be placed over the partition between pens and mounted high enough to insure head clearance and guard against breakage. Bulbs of 100 watts or more used as radiant heaters in aluminum or R. L. M. dome reflectors may be used to form electric pig brooders which are helpful in saving small pigs and lambs.

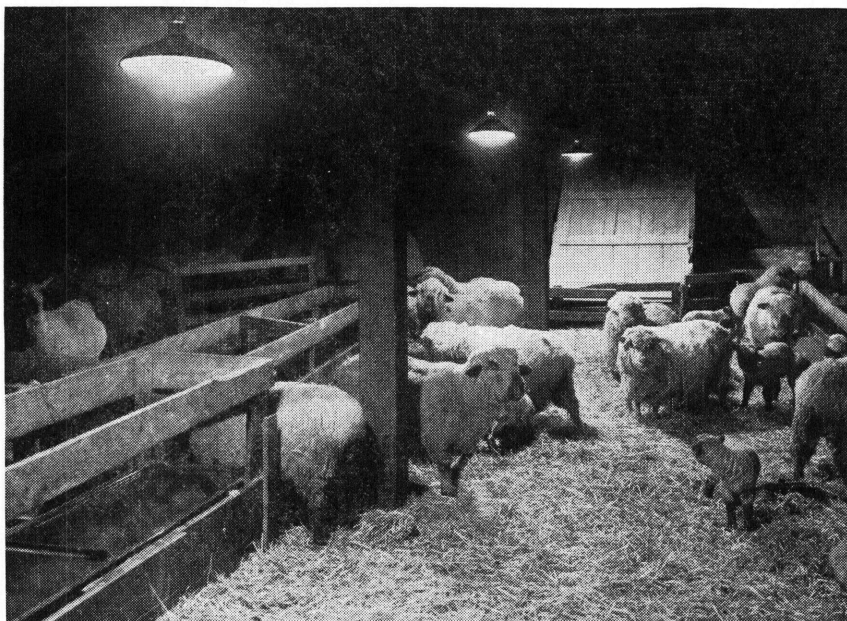
Poultry house

Light is needed in and around the poultry house for feeding, cleaning, record keeping, culling, candling, and other general and emergency needs. Certain physiological effects of light on hens appear to be beneficial. In addition many poultry raisers regulate the length of working day for the chickens to increase egg production in seasons of high prices. This so-called night lighting can also be used for hastening the maturity of late-hatched birds and for prolonging fall production.

Most of the light in the poultry house should fall on the feed hoppers and watering troughs to allow the birds to continue active for several hours after dark or before daylight. In general, bulbs of 60 watts or more should be mounted at the ceiling with reflectors, spaced 10 to 12 feet apart and midway between the dropping board and front wall (fig. 38). A small amount of light should fall on the roosts, and some should reach well back under the dropping boards. Two lights are required for the ordinary poultry unit of 200-birds capacity. When wiring the house, convenience outlets should be provided for attaching water heaters, or other devices. Sometimes ruby-colored lights are used to prevent or control cannibalism among chickens.

Lights used in the morning or evening, or both, to stimulate egg production may be controlled by automatic time switches. Ordinary

Figure 37.—Sheep barn well lighted by single row of lamps in reflectors mounted on central girder



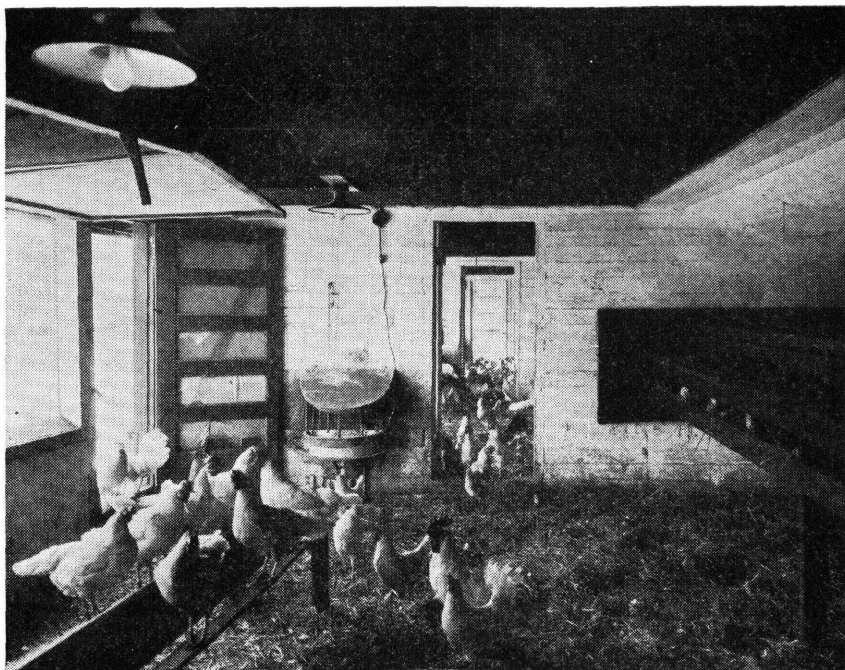


Figure 38.—Proper spacing and mounting of lighting units in a poultry house

alarm clocks may be utilized for operating light switches. A chart (fig. 39) shows the variation in the number of hours of sunlight for latitudes similar to central Iowa or Illinois (41° north latitude) between the autumnal and vernal equinoxes (September 21 to March 21). It also shows when artificial lights should be turned on and off to provide a 12-hour work day for hens. As indicated, this can be done either by providing equal times of lighting in morning and evening, or by morning lights only. With evening lighting, provision for automatic dimming of the lights is desirable so that the light is gradually reduced to encourage the birds to get on the perch before complete darkness. Turning off the main lighting and turning on 10-watt lamps located about 20 feet apart on the ceiling give satisfactory results.

Lighting will not take the place of good flock management, however, and interruptions, irregular lighting, or too long a season of lighting may cause trouble. Bulletins giving fuller information about poultry management may be obtained from most of the State colleges.

Feed room

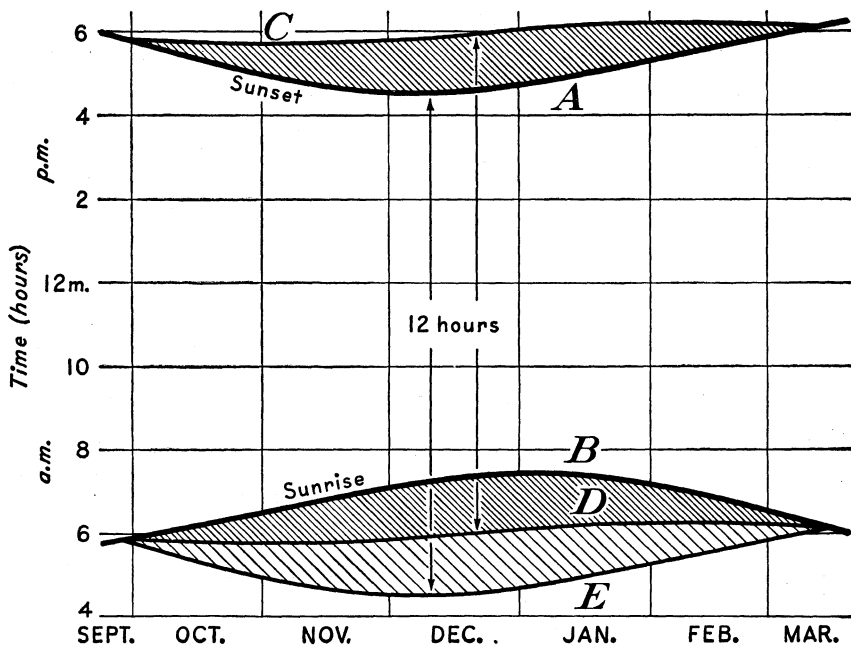
In any room or enclosure where grain or feed products are ground or handled in sufficient quantities to create a dust cloud, an explosion or fire hazard may exist. Use fixed and dustproof fixtures (fig. 40) for

general lighting with the switches outside the dusty room, and eliminate, so far as possible, the use of a portable lamp. All portable lamps, if used, should have dustproof globes with approved types of guards. Mount fixtures at the ceiling over the machinery and make sure that the light falls where the operator needs it for safety. A 100-watt bulb placed conveniently over the grinder or scale will usually provide adequate lighting. Electric lanterns or flashlights—not open flames—should be used in dusty places where electric current is not available.

Silo and chute

A good light, having a conveniently located switch, decreases the risks involved in the daily task of climbing the chute ladder into the silo and makes the chore easier. In addition good light enables the feeder to see and discard spoiled silage. In a silo 30 to 40 feet high a 100-watt bulb with R. L. M. reflector placed at the top of the chute near the silo doorway gives light in both. Ample light for loading silage at the bottom of the chute should be provided. This light if placed on the same switch line may also serve as a pilot light to show

Figure 39.—Variation in hours from sunrise to sunset for 41° north latitude for fall and winter months: A, hour of sunset; B, hour of sunrise; C and D switch time to obtain a 12-hour day with equal forenoon and afternoon lighting; E, switch time for morning lighting only



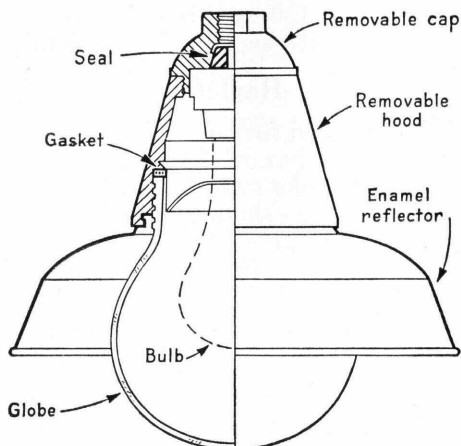


Figure 40.—Cut-away view of a vapor-proof lighting unit. This is also dustproof

if the upper light is burning (fig. 41). In high silos and those of large diameters a portable light on a safety cord may be mounted on a reel or plugged in suitable convenience outlets in the chute. To obviate

Figure 41.—Light mounted on reel extension cord in silo chute to permit adjustment for height. Switch is located at bottom of chute



the use of a portable lamp a 150-watt bulb in a reflector or a projector type bulb of the same size at the top of the silo may be used.

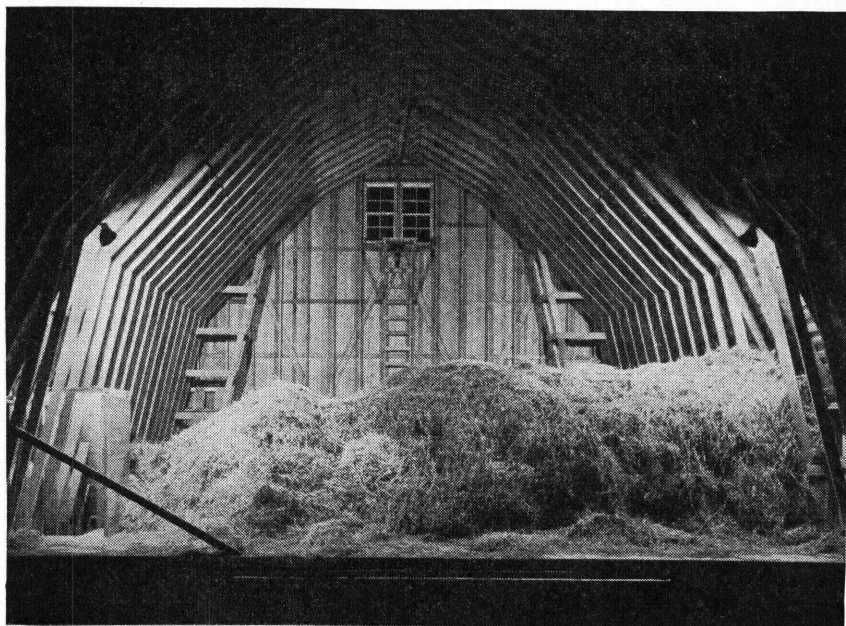
Hayloft

A light in the loft is needed for convenience and safety and should be so used as to reduce the hazards of fire. If oil lanterns are used they should be hung on hooks or snaps within easy reach to avoid danger of fire. Electric lights should be located in a high protected position, with consideration given to convenience and to safety in cleaning and replacing bulbs. In short barns or hay bays of 50 feet or less 100-watt lamps with angle reflectors (fig. 42) at each end or projector-type bulbs may serve satisfactorily. With longer barns more lights may be required. Particular attention should be given to providing glareless light over chutes and stairways. Dusttight lighting fixtures and wire protectors are required in some States and will reduce the fire risk. They should always be used in lofts where chopped hay is stored.

Farm shop and machine shed

Lighting requirements for the farm shop and machine shed vary with farm practices. It is often necessary to repair tractor, truck, automobile, or farm machinery, at night in order to be ready for work

Figure 42.—Lights with angle reflectors used to light hay bays on either side of a central cross driveway where hay cannot reach them. Angle reflectors or projectors can be used at ends of barn



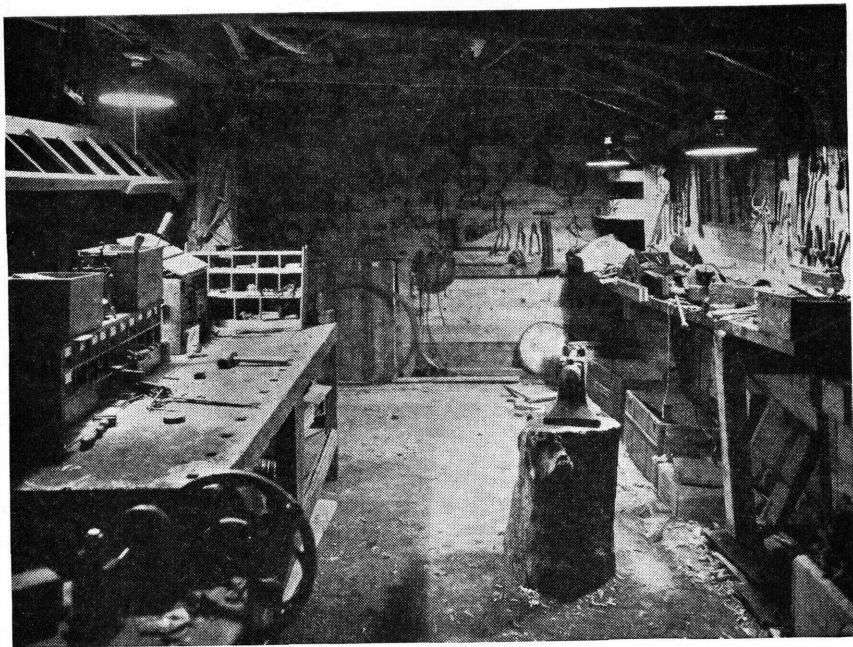


Figure 43.—A well-lighted workbench speeds up emergency repairs

the next day. Bulbs of 100 watts each, in reflectors, placed at the ceiling or 10 feet above the ground at 10- to 12-foot intervals and over the workbench and machines give good light for such activities (fig. 43). In many farm shops the light over the workbench will also provide part of the general lighting. An extension cord of heavy rubber with a 50-watt rough-service lamp equipped with reflector or shade and suitable guard should be available and there should be convenience outlets to permit plugging it in whenever needed.

Garage

A light in the garage is a convenience. A double convenience outlet will permit plugging in a light or an extension cord or electric tool. If used as a shop, the directions in the preceding paragraph will apply.

Other farm buildings

Other farm buildings which need lights are the pump house, spring house, outdoor toilets, and fuel sheds. Due precaution for safety must be exercised where highly volatile fuel is stored by using vapor-proof fixtures and proper switch control. Where there is a chance of coming in contact with water pipes or pumping equipment when touching a light fixture or a switch, porcelain or moulded fixtures and switches should be used and any metal-covered wiring should be carefully grounded to minimize the possibility of electric shock.

On some farms special lighting for grading, washing, or packing of fruit, or for roadside stands may be provided according to individual need. Blue daylight bulbs or daylight fluorescent lamps are available which permit color selection and grading of fruits and vegetables. Satisfactory illumination for such operations may be obtained by using a 150-watt daylight lamp in a R. L. M. reflector over the grader. In storage cellars, refrigerated storages, and packing houses, good general lighting is required for storing and handling of the product in barrels, baskets, or boxes; 100-watt bulbs mounted at the ceiling and spaced 10 to 12 feet apart along the aisle may be used. In refrigerated storages vapor-seal fixtures and wiring should be used.

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